

A COMPARATIVE STUDY OF
TRADITIONAL FOOD INSPECTION VS. HAZARD ANALYSIS
CRITICAL CONTROL POINTS APPROACH FOR CONTROL
OF SALMONELLOSIS IN BAHRAIN

by

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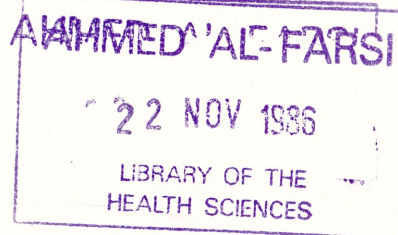
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DEDICATION

I wish to dedicate this project
to my wife Seema
in appreciation
for her constant encouragement,
love, and prayers.

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I. Introduction

Since the beginning of this century, health personnel have worked diligently to define the epidemiology of salmonellosis and the ecology of Salmonella and to develop new techniques to isolate this organism. Others have worked harder to define the major sources and mode of transmission of Salmonella to humans and to livestock.

University professors, researchers, and other health and food-regulation staff have collaborated in conducting studies and seminars on Salmonellae. Many of these specialists have suggested different control measures to protect humans and animals from disease caused by Salmonella. However, all these efforts have failed to solve, or even significantly decrease, the incidence of salmonellosis.

Salmonellosis is a significant problem in the developed and the developing world in terms of losses both for individuals and the affected countries at large. This report discusses the existing traditional food inspection and proposed hazard analysis critical control point approach and suggests a solution for controlling Salmonella.

II. Objectives and Purpose of the Study

The objectives of this special study project are to:

- A. Analyze the existing traditional method of food inspection to identify its weak points.
- B. Identify the components of Hazard Analysis Critical Control Points (proposed program) to determine:
 - 1. Whether components of such an approach are absent from the program in Bahrain,
 - 2. Whether it would be feasible to introduce these program components in Bahrain, and
 - 3. Make recommendations to improve the existing control method in Bahrain.

III. Review of Literature

A. Characteristics of Salmonella

Salmonella are aerobic and facultatively anaerobic, nonsporeforming, motile rods that have peritrichous flagellae and are gram-negative (6, 16).

The organisms' optimal growth temperature ranges from 37⁰C to 43⁰C. However, they are destroyed at 54⁰C and above (60⁰) if the exposure time is long enough. These organisms can grow within a PH range between 4.1 and 9.0 (optimal range 6.5 - 7.5), and they will multiply in an environment with high moisture and relatively low sugar and salt concentrations (29). Salmonella multiply at water activity values

(^aw)* above 0.945 (37). It should be noted that Salmonella resist extinction even under hostile environmental conditions. For example, Salmonella remain viable in frozen foods for several months (6, 42), freezing, however, is effective in preventing their growth, but, once they have returned to a more favorable temperature, Salmonellae will resume their growth.

Salmonellosis is an acute foodborne infection characterized by abdominal pain, diarrhea, nausea, vomiting, fever, chills, headache, and, occasionally, muscular pain.

It has been reported that 2,200 known serotypes of Salmonella can cause salmonellosis (4). Bacteria of most serovarieties need to be present in sufficient quantity to overcome body defenses to cause infection (4). A few studies have suggested that illness can be caused by as few as 10^3 Salmonella (4, 10, 11). The hosts' age and health conditions seems to be an important determinant of susceptibility to Salmonella. For example, for young children, the elderly, the sick, and malnourished persons, the likelihood of developing Salmonella infection appears higher than for the rest of the population (4, 10, 11, 18, 40).

* Water activity (^aw): water activity is a useful measurement of the amount of available water (which permit growth to microorganisms) in a food. It is the ratio of the food's water vapor pressure to the vapor pressure of pure water at the same temperature (14).

B. Vehicles and Contributing Factors of Outbreak

Foods of animal origin are the main vehicles of foodborne salmonellosis (10, 18, 29, 38).

Animals that are sources of food (fowl, cattle, swine, etc.) may become infected while they are on farms by acquiring Salmonella from contaminated feed and feed ingredients, water, and contact with other infected animals (10, 18, 38, 47). The infection rate increases as swine or cattle are transported to slaughter houses where they are kept in pens (10). The organisms are transmitted at processing plants to the hands of food handlers who deal with these animals (17) and to equipment surfaces. In the processing plants, Salmonella can spread to different cuts of meat during processing (11, 17, 63) from contaminated surfaces of equipment and hands.

It has been established that salmonellosis is one of the major diseases transmissible to humans through the consumption of foods. Foods most frequently reported as vehicles of salmonellosis are beef, chicken, turkey, pork, milk, and homemade ice cream (containing eggs) (2, 9, 10, 15, 17, 18, 23, 34, 38, 58, 69). However, other food items such as dry milk, fish, chocolate candy, yeast, coconut, and cotton seed protein also have been incriminated in outbreaks (10, 18, 38). The food items that serve as vehicles of transmission of salmonellosis could differ slightly

from one country to another. For example, in the United States beef, turkey, and homemade ice cream were the most frequently reported causes of salmonellosis during the period 1968-77). In Canada, turkey was the most frequently reported vehicle of transmission during 1973-75 (18). (See Table 1)

In Bahrain the available data are insufficient to determine the vehicles of transmission. However, poultry, meat, eggs, and dairy products are assumed to be major vehicles.

It has been reported in the United States that specific factors contribute to outbreaks of salmonellosis. These factors are: improper cooling of food, inadequate cooking or thermal processing, eating of contaminated raw food products and cross contamination (10, 11, 18).

These contributing factors for salmonellosis could differ from one country to another. Table 2 shows the specific factors contributing to outbreaks of salmonellosis in the United States, Canada, and England and Wales. Factors contributing to outbreaks of other foodborne diseases could also differ slightly from those causing outbreaks of salmonellosis (7, 13, 17, 19).

TABLE 1. Number of recent Salmonellosis outbreaks traced to specific foods in the United States, Canada, and England and Wales.

Food	U. S. 1968-1977	Canada 1973-1975	England & Wales 1969-1976
Beef	40	2	12
Pork/Ham	13	3	47
Mutton	-	1	1
Other Meats	1	1	14
Turkey	30	15	67
Chicken	11	3	72
Other Poultry	1	1	2
Eggs	5	2	2
Ice Cream (eggs)	17	1	-
Sweets, desserts (eggs)	5	4	2
Milk	4	-	60
Cheese	1	-	-
Fish, shellfish	4	-	1
Vegetables, fruits	1	3	-

Source: Bryan (18)

TABLE 2. Factors that contribute to outbreaks of Salmonellosis in the United States, Canada, and England and Wales (by percent)

Factors	United States (1973 - 1976)			U.S. 1961- 1976	Canada 1973- 1975	England/ Wales 1969- 1976
	Food Service	Homes	Food Processing			
<u>Factor affecting growth</u>						
-Improper cooling	68	30		47	41	63
-Improper hot holding	25			14	5	15
-Lapse of day or more between preparation and serving	46			21	18	52
-Use of leftovers				4		
-Faulty fermentations			17	1		
-Inadequate thawing						4
<u>Factors affecting survival</u>						
-Inadequate cooking, heat, processing, canning	4	10	25	21	10	41
-Inadequate reheating	50	4		13		22
<u>Factors affecting Contamination</u>						
-Contaminated raw ingredients	4	35	50	32	14	41
-Cross-contamination	29	11		21	23	26
-Inadequate cleaning of equipment	32	4	8	15	14	19
-Infected persons	11			13	18	4
-Unsafe source				1		30

Source: Bryan (18)

C. Salmonellosis in Bahrain

Salmonellosis has been one of the major foodborne diseases in Bahrain for a long time (Table 3). The number of Salmonella isolated from human specimens has been increasing each year (with only small fluctuations).

Eighty-nine different serotypes of Salmonella were isolated in Bahrain in 1981 (54), and a total of 96 different serotypes of Salmonella other than S. typhi and S. paratyphi were isolated in 1984 (55).

In Bahrain, thousands of dollars are spent on treating cases of salmonellosis and examining food handlers. Thousands of food handlers are examined for Salmonella and other foodborne pathogens each year. Examples of some tests are given in Tables 4, 8, 9). Foodhandlers with positive stool specimens are allowed to work only when at least two stool cultures are negative. This practice increases the cost of salmonellosis. However, the costs of salmonellosis to society are more extensive than just the cultures. Salmonellosis is extremely expensive in terms of the pain and suffering it creates, and in terms of the hospitalization of victims. Other costs include the loss of income due to the work days lost and, finally, the cost of control measures (12, 16, 33, 43, 64).

TABLE 3. Reported Cases of Salmonellosis in Bahrain 1976-84

	1976	1977	1978	1979	1980	1981	1982	1983	1984	Total
Typhoid Fever	55	67	157	119	290	157	223	58	157	1283
Para-typhoid fever	12	11	16	5	7	8	8	7	10	84
Other Salmonellosis	8	52	187	149	154	285	173	227	160	1396

Data from, Ministry of Health, Annual Report, State of Bahrain (54, 55)

TABLE 4. Stool specimens from food handlers cultured for Salmonella and Shigella, Bahrain, 1979-1984

1979	1980	1981	1982	1983	1984
11,736	15,428	13,369	15,934	15,136	18,127

Data from, Ministry of Health, Annual Report, State of Bahrain, (54, 55).

D. Salmonellosis in the United States Compared with Bahrain

It has been reported that the incidence of salmonellosis in the United States has increased since the beginning of the surveillance program in 1962 (10, 18, 35, 71, 73).

It has been estimated that 1.3 million Salmonella infections, and more than 100 deaths due to Salmonella, occur in the United States each year (40). The average cost per case of salmonellosis was \$480 - \$645 in 1978 - 1980 (70), and the approximate

total annual cost of Salmonella is \$1 billion (40).

E. Possible Sources of Salmonella in Bahrain

1. Imported contaminated animals food sources

Bahrain produces a very small portion (not more than 6%) of the total food requirements of its people (62). Therefore, the country depends mainly on foods imported from other countries. Thousands of live animals (for slaughter), tons of poultry, and tons of meat and dairy products are imported each year. With the technology available today, it is not possible to assure that raw animal food products are free of Salmonella (43, 49), and it is extremely difficult to protect animals from getting infected with Salmonella (65). Salmonella can survive and multiply in these foods if proper control measures are not adequate during transportation, storage, processing, and, later on, during preparation.

An example of lack of proper control measures in Bahrain is the following: animals are held in dirty pens for a long time before being slaughtered, causing the rate of infection to increase among the animals because of cross-contamination (11, 18, 63). More contamination occurs during slaughtering processes in the slaughter houses. In addition, multiplication of

Salmonella occurs when the meats are exposed for the consumer in the market under the environmental temperatures. Contamination, survival and growth of Salmonella are the hazards of concerns.

2. Imported contaminated animal feeds

Some animal feeds are imported from other countries. Feeds play a major role in transmission of Salmonella to livestock (1, 10, 11, 17, 18, 47, 58).

Some Salmonella serotypes isolated from human specimens in Bahrain were similar to those isolated in the countries from which foods and feeds are imported.

3. Locally produced foods

Although little food is produced in Bahrain, foods that are locally produced are not monitored properly by health personnel. For example, during processing in small, private concerns that process poultry, meat and milk food items can become contaminated with Salmonella.

The incidence of salmonellosis in Bahrain is increasing year after year (41, 52). It is a major public health problem which has been with us for a long time. The main reason salmonellosis has not been controlled is that routine traditional food inspection has not been addressing the causes of salmonellosis directly.

It is now becoming clear that we must modify this traditional approach if we intend to control salmonellosis.

IV. Methodology

This is a descriptive study for which the information was collected from:

1. the literature,
2. professionals and teachers in the field,
3. field visits to some local health departments and restaurants in the Atlanta metropolitan area, and
4. data from Bahrain.

Telephone interviews were held with professionals in New York Health Departments concerning the traditional approach to salmonellosis control, and the Hazard Analysis Critical Control Point (HACCP) approach. The following data were collected:

1. the reasons for applying HACCP,
2. the difference between traditional and HACCP inspection,
3. the limitation and disadvantages of both approaches, and
4. what results have been achieved so far after applying HACCP.

The HACCP approach is a new foodborne disease control method which has been applied in New York State recently. It was for this reason, that New York was selected.

V. Information About Bahrain

A. Geography

The State of Bahrain consists of 33 islands with a total land area of about 677.9 square kilometers. It is located in the Arabian Gulf, about 18 miles east of Saudi Arabia and west of Qatar Island. The population was about 350,798 according to the 1981 census and was estimated to be 400,280 in 1984 (55). The Capital of Bahrain is Manama, where government offices, companies, oil fields and a refinery are located.

B. Climate

The climate of Bahrain is hot in summer and cool in the winter. The temperature rises to about 41°C in July and August, and drops sharply in January and February to about 17°C. The humidity is high with an average of 94%. The average annual rainfall is about 3 inches.

C. Economy

Although the first oil well in the Gulf region was found in Bahrain in 1931, oil revenues have been declining and the oil reserve is limited and expected to be depleted by the end of this century. For these reasons, the government of Bahrain has directed its economy towards developing other means of generating revenue, such as, building hotels and building new industries. Examples of these new industries are oil

refining, aluminum smelting, ship building and repair, and banking. According to the 1978 census the Gross National Product per capita for Bahrain was \$4,100 in U.S. dollars.

D. Education

In Bahrain, free education is provided from primary to college level through a network of governmental schools. In addition, there are some private schools which charge fees. Higher educational institutions are also available. These include the Gulf University, University College of Arts and Sciences, Gulf Polytechnic and College of Health Sciences (CHS).

CHS has been playing a major role towards training of the mid-level health professionals. CHS offers a two-year training program leading to the Associate Degree in different health-related fields. The college also started a Bachelor of Science degree in Nursing recently.

The Arabian Gulf University College of Medicine offers a five-year course and admits about 60 students a year. The number of students is expected to grow steadily to around 600 over a 10-year period. This University should play a major role in post-graduate clinical and research training for the Gulf region.

E. Health Problems

The major causes of mortality and morbidity in Bahrain are similar to those found in other developed

and developing countries. Table 5 lists the main causes of death in Bahrain in descending order of their frequency. The reported communicable diseases in Bahrain are shown in Table 6.

F. Health Care Delivery

The government of Bahrain has made free health care available to all people on the islands. About 95% of all health care is delivered by a system of governmental hospitals, clinics, and a network of 18 health centers spread throughout the country. Secondary and tertiary health care is mainly provided through the Salmaniya Medical Center (730 beds). In addition to governmental health services, private systems are also available.

Protection of public from hazards and threats to their health is further supported by the work of the Public Health structure which provides the following: about 400,000 immunization a year, food inspection, rodent and insect control, occupational health, health education, nutrition, and vital statistics. (Figure 1)

Bahrain is working hard toward fulfilling the World Health Organization's program of "health for all by the year 2000."

TABLE 5. Major Causes of Death in Bahrain, 1984

Causes of Death	Number of Deaths
Diseases of circulatory system	417
Certain conditions occurring during the perinatal period	185
Unknown	150
Injuries and poisoning	150
Neoplasms	135
Diseases of the respiratory system	68
Endocrine, nutritional, metabolic and immune disorders	41
Diseases of the genitourinary system	37

Data from Ministry of Health, Annual Report, State of Bahrain, 1984 (55).

TABLE 6. Major Reported Communicable Diseases in Bahrain
From Ministry of Health, Annual Report State of
Bahrain, 1984 (55)

Diseases	Number of Cases, by Year				
	1980	1981	1982	1983	1984
Typhoid Fever	290	257	223	58	157
Para-Typhoid Fever	7	8	8	7	10
Other Salmonellosis	154	285	173	227	160
Shigellosis	263	221	162	117	88
Amoebiosis	176	72	93	54	52
Viral Hepatitis	213	292	214	224	190
Food Poisoning (infection and intoxication)	7	7	5	6	21
Streptococcal Sore Throat	273	249	271	261	312
Whooping Cough	106	76	22	33	15
Meningococcal Infection	1	2	3	4	4
Other Meningitis	22	40	17	21	10
Pulmonary Tuberculosis	172	189	140	215	175
Non-Pulmonary Tuberculosis	47	73	16	17	33
Chicken Pox	836	1494	1334	2337	3550
Mumps	3816	757	677	2214	1852
Influenza	4139	4689	4486	4426	4475
Measles	1861	329	1147	438	1134
Rubella	59	156	75	200	117

FIGURE 1. Chart Represents the Directorate of Public Health

Directorate of Public Health						
Admin. and Support	Communicable Diseases	Environ. Health	Food Hygiene	Nutrition Unit	Health Education	Laboratory
Administration and vital statistics (birth and death)	-Communicable diseases -Port health	-Insect and rodent control -Water and institutional hygiene	-Port food inspection -Inside food inspection (restaurant and food storage)	-Nutrition and food studies and advice	-Media preparation -Health education	-Chemical examination -Bacterial examination -Parasitology diagnosis
						-Environ. engineering -Inspection-Occupational health

Information adopted from, Ministry of Health, Annual Report, State of Bahrain (54).

VI. Food Inspection in Bahrain

The food hygiene section of the Public Health Department consists of about 35 members (supervisors/inspectors) who have completed a two-year public health study program after their secondary school education. In addition, they attended an on-the-job training program for three months. Some of the inspectors have been working with public health for more than 20 years. The average working period for the inspectors is about 10 years. Most of the inspectors did not receive further training in food inspection after they joined the Public Health Department. The responsibility of the food hygiene section is to insure the safety, soundness, wholesomeness, and high hygienic standard of foods, whether imported or produced locally, to protect the consumer from foodborne diseases.

The food hygiene program consists of two sections, the port of entry section and the internal section.

A. The Port of Entry Section

There are five authorized ports of entry in Bahrain. Four are sea ports through which all types of foods are imported and one is the air cargo port through which fresh fruits, chilled meat cuts and carcasses are imported. All food items imported through these ports are physically inspected by the health inspectors. Inspection is mainly based on visual and personal judgement. This involves

observing:

1. expiration and production dates on the cans and other prepackaged food items,
2. rusty or bulging cans, and
3. defrosted perishable frozen food items, such as, meat, poultry, and ice-cream.

All inspection is based on the visual appearance of the food items. Food samples are sometimes taken for bacteriological and chemical analysis (54, 55). Food samples, bacteriological tests and pathogens looked for are shown in Table 7.

B. Internal Section

This section is responsible for inspection of all food premises and food marketing places. There are about 5,000 food establishments on the islands (62). The inspectors make routine and unannounced visits on the average of eight times a year to each establishment (57). During their visits, the inspectors mainly emphasize:

1. construction requirements such as walls (whether painted and clean), floors, ceiling, ventilation, illumination, and other such aspects of the building.
2. Validity of the Health Certificates

The inspectors place great emphasis on the validity of health certificates for which, each foodhandler is required to have a medical fitness certificate. This certificate is issued after

TABLE 7. Food specimens, tests done, and pathogens looked for, Bahrain, 1985.

Samples	Tests	Pathogens looked for
Raw foods	Total plate count ^{a*} Coliform count	<u>Salmonella</u> , <u>Shigella</u> <u>Staph. aureus</u> , <u>Vibrio cholerae</u> , <u>Vibrio parahaemolyticus</u> .
Frozen foods	Total plate count ^{a*} Coliform count	<u>Salmonella</u> , <u>Shigella</u> , <u>Staph. aureus</u> , <u>Vibrio cholerae</u> .
Canned foods	Total plate count ^{a*} Spore count	<u>Salmonella</u> , <u>Shigella</u> , <u>Staph. aureus</u> , <u>Clostridium perfringens</u> yeasts and moulds.
Seed products	Spore count	<u>Bacillus cereus</u> , <u>Clostridium perfringens</u> moulds.

* a refers to aerobic mesophilic count

clinical and microbiological examination of food handlers are completed (Table 4). For example, foodhandlers are required to submit stool specimen to be examined for Salmonella serotypes, Vibrio Cholerae, Shigella and parasites. In addition to stool examination, foodhandlers in Bahrain are required to take a tuberculosis skin test and chest X-ray prior to employment in a food service establishment.

3. Dates on prepackaged foods

Bahrain requires all imported prepacked foods to be labelled. Manufacturing and expiring dates are the main points that determine the safety of food in Bahrain. For this reason, health inspectors place great emphasis on dates on packages during their routine inspection of food premises.

C. Shortcomings of the Inspection in Bahrain

1. Inspection in Bahrain is not done properly. For example, it is not possible to detect foodborne pathogens by visual inspection. However, statistical significant laboratory testing of food should be done upon their arrival in a country. Concerning Salmonella, it is not practical to sample raw foods of animal products because those food items are known to be frequently contaminated with Salmonella, so there is no need to check for something already known.

Nevertheless, laboratory sampling and testing of certain heat processed foods of animal origin, their products and animal feed should be done upon their arrival in a country. Statistically sound sampling plans should follow recommendations of the International Commission on Microbiological Specifications for Foods (44, 45). Contaminated feed or foods which will not receive further heat treatment should be rejected or reprocessed (18).

2. All major studies, whether in the United States or elsewhere, show that the contributing factors of salmonellosis and other foodborne illness are improper cooling, inadequate cooking, improper hot holding and cross-contamination (2, 14, 35). The construction of the food establishment is not a major factor that leads to outbreaks of salmonellosis (6, 11, 14). Physical inspection of food establishments should not be ignored totally, however, because some of these requirements might have relationship with Salmonella. For example, separation of the raw food area and the cooked food area could prevent cross-contamination.

The contamination and time-temperature abuse of food is more important and responsible for outbreaks of salmonellosis (26, 30, 31, 32, 59), rather than the illumination, the ceiling or the

type of aprons or head covers the food operators wear.

3. Certification of foodhandlers is not recommended as a method for prevention of foodborne salmonellosis (14, 36, 67), because the absence of Salmonella from a specimen is not an indicator of absence of infection. Excretion of Salmonella might be absent or unevenly distributed in a specimen, or the organisms might be excreted in small numbers (14, 36, 67), and thus not recovered from a single specimen.

Since the main sources of Salmonella are raw foods of animal origin, humans could become infected with Salmonella after they eat contaminated foods of animal products. Furthermore, people could be healthy the day they give the specimen and then become infected the next day. Carriers of foodborne illness often show negative stool cultures during a single examination (14, 67). A group of medical and veterinary experts in Europe concluded, in a meeting concerning foodhandlers, that routine medical examinations of foodhandlers (particularly examination of fecal specimens) has nothing to do with the transmission of foodborne diseases to man. They suggested that these examinations should be discontinued (67).

TABLE 8. Parasites seen by microscopic examination of stools from foodhandlers, Bahrain, 1979-1984.

Parasites Isolated	1979	1980	1981	1982	1983	1984
<u>Ova:</u>						
<u>Trichuris trichiura</u>	1273	1525	1050	886	863	904
<u>Ascaris lumbricoides</u>	1080	974	1144	1189	1317	1173
Hook worm	917	861	609	657	734	933
<u>Hymenolepis nana</u>	57	77	44	35	43	49
<u>Clonorchis sinensis</u>	7	18	-	-	-	-
<u>Enterobius vermicularis</u>	5	10	9	10	1	13
<u>Schistosoma mansoni</u>	1	-	-	-	-	-
Taenia	-	3	-	1	3	1
<u>Cysts and Trophozoites:</u>						
<u>E. histolytica</u>	23	3	4	-	2	-
<u>Trichomonas hominis</u>	128	134	22	13	13	16
<u>Balantidium coli</u>	1	3	0	-	-	-
<u>Giardia lamblia</u>	285	420	533	478	359	494
<u>Larvae:</u>						
<u>Strongyloides stercoralis</u>	84	119	100	89	106	131
Total No. of tests	11547	12869	12583	13881	14728	16633
Total positive for parasites	3861	4147	3515	3358	3441	3714
% positive for parasites	33.44	32.22	27.93	24.19	23.36	22.33

Source: Ministry of Health, Annual Report, State of Bahrain (54, 55)

TABLE 9. Enteric pathogens isolated by culture from stools of foodhandlers, Bahrain 1979-1984

Organisms Isolated	1979	1980	1981	1982	1983	1984
<u>Salmonella typhi</u>	10	19	8	5	6	7
<u>S. paratyphi A</u>	0	0	0	1	-	1
<u>S. paratyphi B</u>	0	3	0	-	-	7
<u>S. paratyphi C</u>	1	0	0	-	-	-
Other <u>Salmonella</u>	597	1632	734	584	810	604
Total <u>Salmonella</u>	608	1654	742	590	816	619
<u>Shigella flexneri</u>	33	11	1	6	1	-
<u>Shigella sonnei</u>	17	7	0	10	4	1
<u>Shigella boydii</u>	15	16	2	-	-	-
<u>Shigella dysenteriae</u>	5	2	0	1	-	-
Total <u>Shigella</u>	70	36	3	17	5	1
Total cultures done for <u>Salmonella</u> and <u>Shigella</u>	11736	15428	13369	15934	15136	18127
% positive for <u>Salmonella</u>	5.21	10.72	5.55	3.70	5.39	3.41
% positive for <u>Shigella</u>	0.60	0.23	0.02	0.11	0.03	0.006

Source: Ministry of Health, Annual Report, State of Bahrain (54, 55).

health, foodhandlers should be certified on the basis of what they know about protecting the consumer from food-related illnesses (13, 53). There is a need to educate foodhandlers about foodborne diseases and teach them about the control measures.

4. It is true that dates on prepackaged foods provide the consumer with information about the age of the product. However, manufacturing and expiration dates do not indicate the safety of food items, because they provide no information concerning what happened to foods during production, manufacturing, transportation and storage. Foods might be exposed to extreme fluctuation in temperatures and humidity during transportation and storage, especially if cooling systems are not provided. As a result, some food items change not only color, flavor, texture and nutrient contents but also the safety of the product. Therefore, processing operations, storage and handling practices are more important for the prepackaged foods than the expiration and manufacturing dates.

D. OPSSA Approach

In 1980, the Office of Professional Standards and Systems Analysis (OPSSA), Ministry of Health in Bahrain established a food and waterborne disease

control program. The program's main developments were:

1. an inspection form to be used by the food hygiene section. The inspection form addresses the temperature/time exposures and cross-contamination which are the main contributing factors of Salmonella and other foodborne diseases outbreaks.

2. Training Programs

In addition to the inspection form, OPSSA provided some field training and classroom instruction for the inspectors; moreover, it provided some training for food service managers (57).

3. Computer program.

OPSSA developed a computer system for different information records.

E. Review of Current Inspection Approach

The OPSSA approach had a positive impact on food inspection, because the inspectors started using thermometers for measuring cooling, cooking, and hot holding temperatures. Although the OPSSA inspection form does emphasize factors that contribute to outbreaks of foodborne illnesses, inspection in Bahrain is not very effective in controlling these illnesses, particularly salmonellosis, because the inspectors continue to use the traditional inspection method. For example, the inspector goes into a

restaurant for a short period of time (15-20 minutes) and only observes what is going on during that time. Thus, the inspector misses operations that happened before and after his visit. As the observations are limited, the inspector does not really know the procedures followed during preparation of the food to be sure precautions have been taken to avoid cross-contamination. He also does not know if foods are cooked and reheated adequately and stored in a manner that prevents the contamination, survival, and growth of pathogenic microorganisms. The inspector has to make assumptions about a number of factors by looking at only a very small part of the whole picture. In this short visit, the inspector decides whether or not the operation is adequate and the food is safe for human consumption.

In this traditional type of inspection, the inspector may go in a restaurant and measure the temperature during cooking and cooling and find that all temperatures comply with the standards; however, he will not know what might happen to food afterwards. Conversely, he might go during a period when the workers are involved in cleaning the floors and ceiling or when workers are peeling potatoes or cutting onions. In these cases, the inspector will see only a relatively short phase of the preparation cycle. In such a short period of time inspection is

limited to only looking at the walls, ceiling, and floor, emphasizing aesthetic considerations and not the factors that epidemiologic data have shown to contribute to outbreaks of foodborne diseases. In summary, the traditional method of food inspection is an irrational approach that will not protect the public from the risk of salmonellosis. There must be a better method of controlling this persistent problem.

VII. Hazard Analysis Critical Control Points (HACCP) Approach

Consumer safety is a prime concern of the public health inspector. Aesthetics, consumer acceptance and regulatory compliance must be of secondary importance. Food never becomes a threat to the consumer unless it is contaminated with pathogenic bacteria, toxins, or poisonous chemicals. For salmonellosis to occur, Salmonella must be present in high enough quantities to overcome the individual's resistance. Salmonellosis is unlikely to be a threat unless there are some faulty practices present in the food establishment that permit pathogens to contaminate the food items, survive, and oftentimes multiply. These practices can be identified and controlled by using the HACCP approach.

A. HACCP History:

The HACCP approach provides for a detailed and systematic investigation of food production, processing, and distribution in an attempt to assess

the risk of creating a defective or hazardous food product (56). The HACCP approach, first described at a 1971 conference on food protection (72), has been applied to microbiological control of foods in the food processing and food service establishments and in homes (5, 8, 20, 24, 25, 27, 28, 46, 51, 56, 60, 75). The success of HACCP concept has been discussed by several authors (5, 39, 50, 66, 68).

Many industries have adopted the HACCP approach as a means of microbiological quality control and of providing optimal shelf life of their products (68). Other companies have agreed to use HACCP and to work with the Food and Drug Administration (FDA) to establish this quality control concept (39).

This approach has recently been adopted by the Department of Health Services in Suffolk County in New York State as well as some other places in United States. The sanitarians in Suffolk County were highly satisfied with this new approach.

B. Hazard Analysis Elements and Application:

The Hazard Analysis Critical Control Point concept consists of: (1) an assessment of hazards associated with growing, harvesting, processing/manufacturing, distributing, marketing, preparing or using a given raw material or food product;¹ (2) determination of critical control points required to control any identified hazard(s);² and (3) estab-

lishment of procedures to monitor critical control
3
points. (74)

The HACCP approach has been studied extensively by Bryan (8, 19, 20, 21, 24, 25, 27, 28), and discussed by several other authors (3, 5, 36, 46, 50, 51, 56, 60, 66, 68, 74, 75).

The HACCP approach starts with observing operations and taking appropriate measurements. Then, a process flow diagram is developed which includes all of the processing points and is specific for the food, process, and equipment involved. In HACCP, a detailed and systematic investigation of food production, processing and distribution is carried out. All the findings are analyzed to identify where and how these hazards occurred. The process might consist of making measurements of temperature, pH, water activity (a_w) even microbiological testing of food samples at each appropriate operation point (19, 20, 60). Codes and symbols can be used to indicate the potential or actual contamination, time-temperature exposures, survival, growth of microorganisms of concern (19, 20).

1. "Hazard" includes contamination of food with unacceptable levels of foodborne disease - causing microorganisms and/or contamination with spoilage organisms to the extent that hazards occur within the expected shelf life or use of the products.
2. "Critical Control Point" is a location or a process which, if not correctly controlled, could lead to contamination with foodborne pathogens or spoilage microorganisms or their survival or unacceptable growth.
3. "Monitoring" is the checking or verifying that the processing or handling procedure at the critical control points is properly carried out. (74)

Figure 2 illustrates the flow diagram and the appropriate codes. In this diagram, steps with double borders represent critical control points. The critical control points in this diagram are specific for Clostridium perfringens (20). However, for Salmonella, step three (cooking) in Figure 2 is also a critical control point and should have a double border. The flow diagram should be analyzed, the sources of contamination and processes which enhance survival and growth of microorganisms of concern should be identified.

A proper form (Part 1, Figure 3) should be used to record the hazards, the critical control points, the applicable prevention and control measures for each critical control point, and the type of monitoring required for each critical control point (19, 20). An inspection form may also be useful for hazard analysis, which is helpful to record the deficiencies of the operation. Several inspection forms are included (Figures 4, 5, 6, 7) as examples. Figures 3 and 4 are inspection forms prepared by Bryan (19, 20); Figure 5 is an inspection form used by DeKalb County, Georgia, Health Department (which has no relation to HACCP); Figure 6 is the inspection form used by Suffolk County Health Department in New York and by other departments throughout that state; and Figure 7 is the inspection form prepared by OPSSA and used in the State of Bahrain.

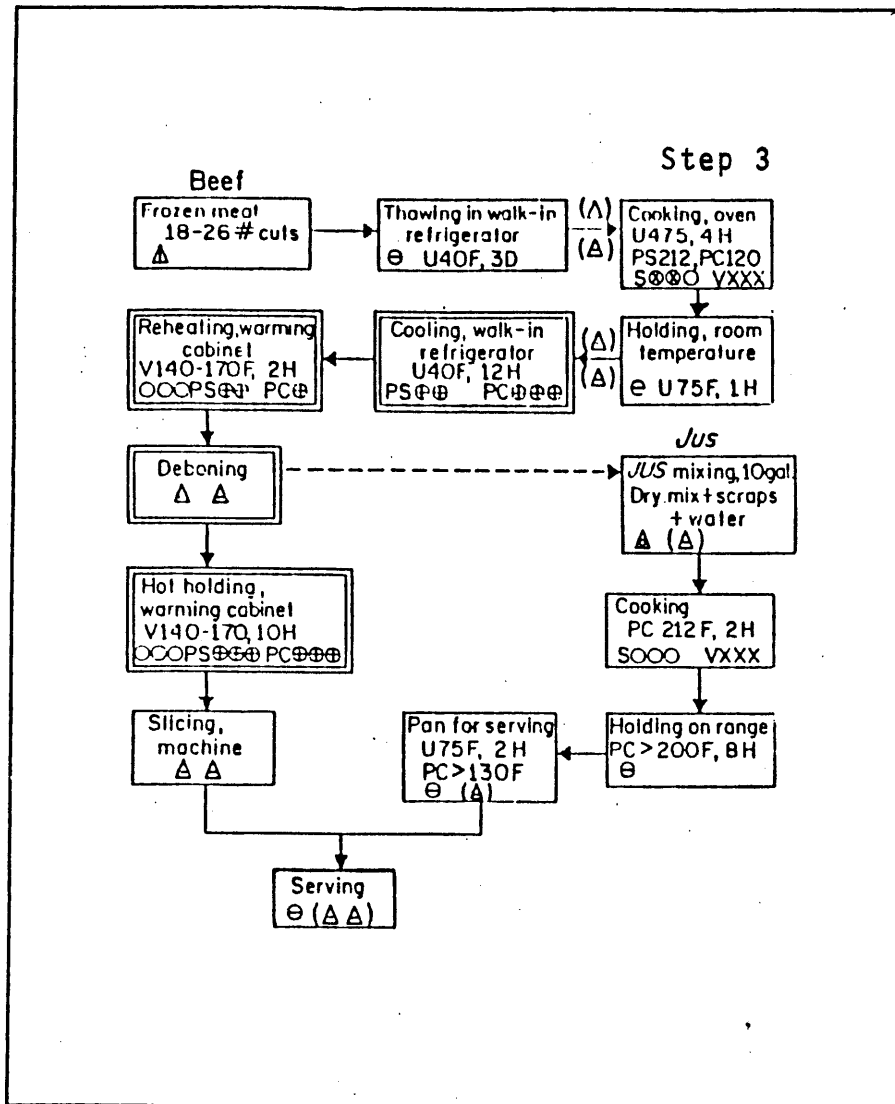


FIGURE 2. FLOW DIAGRAM for preparation of roast beef and jus in food service establishment. Steps with double borders represent critical operations needing immediate control. Symbols are defined in Figure 3. Copied from Bryan (20).

FIGURE 3

From Bryan (19)

Foodservice Hazard Analysis Report
Identification of Product, Determination of Flow Process, and Critical Control Points.

PART I: IDENTIFICATION OF PRODUCT, DETERMINATION OF FLOW PROCESS, AND CRITICAL CONTROL POINTS									
Name of Establishment Address Product(s) Evaluated (Include brand, code, date received) 	Person in Charge at Time of Analysis Title Date and Time of Analysis Physical Appearance pH _____ a_w _____								
Diagrams flow process of operation. (Insert temperatures and times of processes or delays and make appropriate symbol at exact point in operation.) 									
Code Letters and Symbols: <table style="width:100%; border: none;"> <tr> <td style="width:33%; vertical-align: top;"> ☐ Operation ☐ Flow ☐ Critical Operation () Potential S Spores V Vegetative Bacterial Cells ST - Heat Stable Toxin LT - Heat Labile Toxin </td> <td style="width:33%; vertical-align: top;"> PC _____ °F/°C - Product temperature at geometric center PS _____ °F/°C - Product temperature at surface U _____ °F/°C - Unit/ambient temperature _____ min/hours/days </td> <td style="width:33%; vertical-align: top;"> No growth Slight growth Moderate growth Massive growth Survive Killed on surface, survived in center Partial survival Killed Sources of Contamination: Raw product People Equipment/Utensils Other (specify) </td> </tr> </table>				☐ Operation ☐ Flow ☐ Critical Operation () Potential S Spores V Vegetative Bacterial Cells ST - Heat Stable Toxin LT - Heat Labile Toxin	PC _____ °F/°C - Product temperature at geometric center PS _____ °F/°C - Product temperature at surface U _____ °F/°C - Unit/ambient temperature _____ min/hours/days	No growth Slight growth Moderate growth Massive growth Survive Killed on surface, survived in center Partial survival Killed Sources of Contamination: Raw product People Equipment/Utensils Other (specify)			
☐ Operation ☐ Flow ☐ Critical Operation () Potential S Spores V Vegetative Bacterial Cells ST - Heat Stable Toxin LT - Heat Labile Toxin	PC _____ °F/°C - Product temperature at geometric center PS _____ °F/°C - Product temperature at surface U _____ °F/°C - Unit/ambient temperature _____ min/hours/days	No growth Slight growth Moderate growth Massive growth Survive Killed on surface, survived in center Partial survival Killed Sources of Contamination: Raw product People Equipment/Utensils Other (specify)							
<table style="width:100%; border: none;"> <tr> <th style="width:40%; text-align: left;">CRITICAL CONTROL POINTS</th> <th style="width:30%; text-align: left;">CONTROL MEASURES</th> <th style="width:30%; text-align: left;">MONITORING PROCEDURES</th> </tr> <tr> <td style="vertical-align: top;"> Contamination: Survival: Growth: </td> <td></td> <td></td> </tr> </table>				CRITICAL CONTROL POINTS	CONTROL MEASURES	MONITORING PROCEDURES	Contamination: Survival: Growth:		
CRITICAL CONTROL POINTS	CONTROL MEASURES	MONITORING PROCEDURES							
Contamination: Survival: Growth:									

FIGURE 4

Food service Hazard Analysis Report Part 2. Evaluation of Specific Hazards

PART 2. EVALUATION OF SPECIFIC HAZARDS
THE ITEMS CIRCLED BELOW IDENTIFY DEFICIENCIES IN OPERATIONS1. ☐ Preserving and Receiving

- Water and ice are from unsafe, unprotected, or unapproved source(s).
- Raw milk is purchased or used.
- Shellfish is from unapproved or unknown source(s).
- Canned foods are purchased or otherwise obtained from home(s) or other unapproved source(s).
- Swollen canned foods are received.
- Mushrooms are gathered from fields or woods or obtained from other unapproved source(s).
- Meat or meat products are from uninspected or unapproved source(s).
- Cracked or checked eggs are purchased or received.
- Incoming foods and ingredients do not meet microbiological specifications.

2. ☐ Storing Packaged and Raw Foods

- High-acid (pH 4.5 or lower) foods are stored in containers or conveyed in pipes made of metals or alloys that contain or are coated with toxic materials, such as antimony, cadmium, copper, lead or zinc.
- Foods are packaged in materials containing toxicants that could migrate to foods.
- Poisonous substances are stored in the same room as foods.
- Poisonous substances are either not labeled or are improperly labeled.
- Unapproved pesticides are used or pesticides are applied in a manner that could contaminate foods or lead to their contamination.
- Poisons (such as pesticides and cleaning agents) are stored in used food containers or containers sometimes used to store foods.
- Foods are subjected either to: (1) sewage drippage, overflow, or backflow; (2) exposure to water or moisture during storage; or (3) exposure to contamination by insects or rodents.
- Raw, readily perishable foods held at temperatures above 7°C/45°F.
- Foods held in frozen storage at temperatures above 0°C/32°F.

3. ☐ Reconstituting or Thawing Foods

- Dry foods are contaminated during reconstitution by (1) non-potable water, (2) workers' hands, or (3) utensils.
- Foods are not properly thawed before cooking (other than items of 1.4 kg/3 lb or less which can be thawed during cooking).
- Method of thawing not proved to be effective for thawing type of food (raw or cooked) or size, volume, or weight of item.
- Thawed foods are left at room temperature.

4. ☐ Handling and Preparing Raw Foods

- Workers do not wash hands (generate lather) after handling raw animal products (meat, poultry, eggshells, or fish).
- Raw foods are processed in or on equipment or with utensils that are used subsequently for foods that will not be cooked or reheated (without intervening cleaning).
- Raw beef, lamb, or other meat are ground in the same grinder that had been used for grinding raw pork without thorough cleaning between operations.
- Chemicals or food ingredients (such as monosodium glutamate or sodium nitrite) that produce toxic reactions in man are added to foods at levels exceeding culinary requirements during preparation or in known hazardous levels.

5. ☐ Cooking

- Poultry, poultry products, foods containing poultry, or poultry dressing are not cooked to an internal (geometric center) temperature of at least 74°C/165°F.
- Pork, pork products, or foods containing pork are not cooked to an internal (geometric center) temperature of at least 66°C/150°F.

6. ☐ Handling Cooked Products

- Cooked foods have contact with raw animal products.
- Cooked foods are processed on the same equipment or stored in the same containers previously used for raw animal products, without thorough cleaning and sanitizing between each usage.
- Cooked foods are contaminated by thaw water, drip water, or aerosols from raw animal products.
- Workers touch cooked foods with bare hands.

7. ☐ Hot Holding

- Foods are put into hot-holding devices at temperatures below 54°C/130°F, unless hot holding has been proved to be an integral part of post-heating temperature rise in food.
- Foods held in hot-holding devices are at temperatures below 54°C/130°F.

8. ☐ Cooling

- Cooked foods that have either (1) a pH above 4.5 or (2) a water activity (a_w) above 0.85 or (3) a pH above 5 and a water activity above 0.90 are kept at room temperature for 1 hour or more.
- Solid or semi-solid cooked foods are stored in refrigerators at a depth greater than 10 cm/4 in.
- Containers that have a height greater than 10 cm/4 in are used to store solid or semi-solid cooked foods.
- Cooked foods (as defined in 7a) are not cooled rapidly to 21°C/70°F within 2 hours.
- Cooked foods (as defined in 7a) stored in refrigerators do not reach 7°C/45°F within 6 hours after removal from cooking or hot-holding devices.

9. ☐ Reheating

- Foods of a quantity greater than 1.4 kg/3 lb are (1) cooked on a preceding day, (2) cooked several hours before serving on the same day, or (3) left over from previous meals and not reheated to a temperature at the geometric center of less than 71°C/160°F.
- Foods of a quantity less than 1.4 kg/3 lb, but otherwise complying with the above definition, are reheated to a temperature at the geometric center of less than 74°C/165°F.

10. ☐ Serving

- Workers touch foods during serving.
- Foods are otherwise contaminated during serving. (Specify below.)

11. ☐ Cleaning and Sanitary Maintenance

- Kitchen equipment (such as slicers, grinders, cutting boards, storage pots or containers, and preparation utensils) are ineffectively washed, rinsed, or sanitized.
- Equipment and utensils are not thoroughly cleaned and sanitized after contact with raw animal products.
- Cloths and sponges are used to clean preparation surfaces used for raw foods and then are used to wipe surfaces that are to be used for foods that will not be cooked or reheated.
- A sanitary maintenance schedule has not been established and is not in use for all pieces of equipment used for preparation.

12. ☐ Hygiene of Workers

- Persons who have diseases that can be transmitted by foods or who have symptoms (diarrhea, fever, rhinorrhea, jaundice, sore throat) or diseases (cold or sinusitis) that promote the spread of foodborne pathogens or who are infected with certain pathogens (*Shigella* spp., *Salmonella typhi*, or others designated by the health officer to be transmitted by foods) handle foods.
- Workers who have infected lesions (bolls and other pus-containing lesions) touch potentially hazardous foods.
- Workers do not wash hands thoroughly (generate lather) after using toilet, smoking, sneezing, coughing, blowing or picking nose, or touching sores or bandages.
- There are either no facilities or inadequate facilities (lavatory without hot water, no soap, no single-service towels) in food preparation area for hand washing.
- Toilet facilities are inadequate or not functioning.
- Sewage disposal facilities are inadequate or unapproved.

13. ☐ Management

- Managers are not trained or do not demonstrate proficiency in knowledge of foodborne disease hazards or their prevention.
- Managers either have not trained or do not supervise staff in foodborne disease hazards and their prevention.
- A system for control has not been established or initiated for all hazards that have been identified previously.

Note: Illustrate hazards and specify critical control points dealing with contamination, survival and growth on the reverse side of this form.

Other Deficiencies or Further Comments and Recommendations:

Name of Person Making Analysis

Title and Agency

FIGURE 5

Form 3807
(Rev. 1/79)Georgia Department of Human Resources
FOOD SERVICE INSPECTION REPORT

Name of Establishment	Address (Street)
-----------------------	------------------

Sirs: The items marked below as violations in the operation or facilities of your establishment must be corrected. ☐ by next routine inspection or: ☐ within _____ days. Failure to correct violations as noted on this inspection report will result in appropriate legal action against your establishment as provided for in Ga. Laws Code 558 et seq. Food Service Rule 270-5-6. X indicates non-compliance.

Section	Item	Description	Eval Pt	X	✓
FOOD SUPPLIES	1.	Approved Source, Wholesome	5		
	2.	Container, Identified, Dispenser	2		
	3.	Misbranded	1		
FOOD PROTECTION	4.	Storage Practices	2		
	5.	Temperature	5		
	6.	Protected From Contamination	4		
	7.	Toxic Material Control	5		
PERSONNEL	8.	Personnel Hygiene (Hairnets, Tobacco, Etc.)	1		
	9.	Disease Control (Handwashing, Infections, Etc.)	3		
EQUIPMENT AND UTENSILS	10.	Thermometers	1		
	11.	Adequate Facilities Provided	4		
	12.	Approved Method	4		
	13.	Clean Food-Contact Surfaces	4		
	14.	Clean, Non-Food-Contact Surfaces	2		
	15.	Approved Material	3		
	16.	Construction, Installation, Good Repair	3		
	17.	Use of Single-Service Articles	4		
	18.	Storage Practices	3		

Establishment Number									
Yr			Mo		Day		Total Employees		

TYPE ☐ —Commercial ☐ —School ☐ —Tavern ☐ —Hospital ☐ —Nursing Home ☐ —Day Care Ctr. ☐ —Private Club ☐ —Penal ☐ —Other	PERMITTED ☐ —Yes ☐ —No WATER SUPPLY ☐ —Class 1 ☐ —Class 2 ☐ —Class 3	INSPECTION TIME ☐ —1-30 ☐ —31-1 Hr. ☐ —1:01-1:30 ☐ —1:31-2 Hrs. ☐ —2:01 and over F.H.T. ☐ —None ☐ —1%-25% ☐ —26%-50% ☐ —51%-75% ☐ —76%-100%
--	---	--

WATER SUPPLY	19.	Approved	5		
	20.	Hot and Cold Water as Required	4		
WASTE DISPOSAL APPROVED	21.	Garbage, Refuse	3		
	22.	Sewage	5		
TOILET AND LAVATORY FACILITIES	23.	Adequate, Properly Located	5		
	24.	Proper Facilities, Fixtures in Good Repair	2		
	25.	Clean, Proper Supplies Provided	2		
VERMIN CONTROL	26.	Rodents, Flies, Roaches	4		
PLUMBING	27.	Cross Connection, Other	5		
	28.	Plumbing, Other	2		
OTHER FACILITIES	29.	Floors	1		
	30.	Walls and Ceiling	1		
	31.	Lighting	2		
	32.	Ventilation	2		
	33.	Neat and Clean, Other	1		

PURPOSE ☐ —Routine ☐ —Follow-Up ☐ —Request ☐ —Complaint ☐ —Other	TYPE SEWAGE ☐ —Public ☐ —Septic Tank ☐ —Other	ENFORCEMENT ☐ —Routine ☐ —Administrative ☐ —Action Recommended
---	--	---

No. Served Daily					GRADE Possible 100				

Item	Comments and Instructions	Item	Comments and Instructions
Discussed with		Inspected by	
Total		Total	

☐ ROUTINE INSPECTION
☐ REINSPECTION
☐ ILLNESS SUSPECTED
☐ COMPLAINT
☐ OTHER _____

NEW YORK STATE DEPARTMENT OF HEALTH
FOOD SERVICE ESTABLISHMENT INSPECTION REPORT
PART 14 - 1

SEATING CAPACITY		
PUBLIC WATER	YES	NO
PUBLIC SEWER	YES	NO
VALID PERMIT	YES	NO

COUNTY			DIST.			EST. NO.			MO.			DAY			YR.			INSP. BEGAN						
																							AM	PM

☐ SATISFACTORY
☐ UNSATISFACTORY

NAME: _____
ADDRESS: _____
T.V.C. _____

NAME: _____
COUNTY _____ ZIP CODE: _____

[illegible][illegible]

SIGNATURE OF PERSON IN CHARGE

SIGNATURE OF INSPECTOR

FIGURE 6 (Continued)

PART 1 – CRITICAL ITEMS

1. FOODS ADULTERATED OR RECEIVED FROM UNAPPROVED SOURCES. 14-1.10, 1.31, 1.33, 1.34, 1.120, 1.121, 1.122** A. UNPASTEURIZED MILK AND MILK PRODUCTS USED B. WATER/ICE: UNSAFE, UNAPPROVED SOURCES, CROSS CONNECTIONS C. HOME CANNED GOODS, OR CANNED GOODS FROM UNAPPROVED PROCESSOR FOUND ON PREMISES D. CANNED GOODS FOUND IN POOR CONDITION (LEAKERS, SEVERE DENTS, RUSTY, SWOLLEN CANS) E. MEAT AND MEAT PRODUCTS NOT FROM USDA APPROVED PLANTS F. SHELLFISH NOT FROM APPROVED SOURCES, IMPROPERLY TAGGED/LABELED, TAGS NOT RETAINED 60 DAYS G. CRACKED/DIRTY FRESH EGGS, LIQUID OR FROZEN EGGS AND POWDERED EGGS NOT PASTEURIZED H. FOOD, FROM UNAPPROVED SOURCE, SPOILED, ADULTERATED ON PREMISES		5. IMPROPER COOLING AND REFRIGERATED STORAGE OF POTENTIALLY HAZARDOUS FOODS. 14-1.10, 1.40, 1.44 A. SOLID OR SEMISOLID COOKED, POTENTIALLY HAZARDOUS FOODS ARE STORED IN A MANNER WHERE THE FOOD DEPTH IS GREATER THAN 4" B. POTENTIALLY HAZARDOUS FOODS ARE NOT COOLED BY AN APPROVED METHOD WHERE THE PRODUCT TEMPERATURE CAN BE REDUCED FROM 130°F TO 70°F OR LESS WITHIN TWO HOURS AND 45°F OR LESS WITHIN SIX HOURS, (POTENTIALLY HAZARDOUS FOODS THAT ARE COOLING MAY BE UNCOVERED DURING THE COOLING PERIOD.) C. POTENTIALLY HAZARDOUS FOODS ARE NOT STORED UNDER REFRIGERATION EXCEPT DURING NECESSARY PREPARATION OR APPROVED PRECOOLING PROCEDURES (ROOM TEMPERATURE STORAGE.) ACTUAL T° D. POTENTIALLY HAZARDOUS FOODS SUCH AS SALADS PREPARED FROM POTATOES OR MACARONI ARE NOT PREPARED USING PRECHILLED INGREDIENTS, AND ARE NOT PRECHILLED TO 45°F OR LESS BEFORE THEY ARE STORED ON BUFFET LINES IMPROPER ICED STORAGE, ACTUAL T° E. ENOUGH REFRIGERATED STORAGE EQUIPMENT IS NOT PRESENT, PROPERLY DESIGNED, MAINTAINED, OR OPERATED SO THAT ALL POTENTIALLY HAZARDOUS FOODS ARE COOLED PROPERLY AND CAN BE STORED BELOW 45°F AS REQUIRED
2. FOODS NOT PROTECTED FROM CONTAMINATION. 14-1.10, 1.31, 1.40, 1.43, 1.71, 1.110 A. PREPARED FOOD PRODUCTS CONTACT EQUIPMENT OR WORK SURFACES WHICH HAVE HAD PRIOR CONTACT WITH RAW FOODS AND WHERE WASHING AND SANITIZING OF THE FOOD CONTACT SURFACE HAS NOT OCCURRED TO PREVENT CONTAMINATION B. FOOD WORKERS HANDLE RAW AND COOKED OR PREPARED FOOD PRODUCTS WITHOUT THOROUGH HANDWASHING IN BETWEEN C. COOKED OR PREPARED FOODS ARE SUBJECTED TO CROSS-CONTAMINATION FROM RAW FOODS D. UNWRAPPED/POTENTIALLY HAZARDOUS FOODS ARE RESERVED		6. IMPROPER HOT HOLDING OF POTENTIALLY HAZARDOUS FOODS. 14-1.10, 1.40, 1.45 A. POTENTIALLY HAZARDOUS FOODS ARE BEING KEPT BELOW 140°F DURING HOT HOLDING ACTUAL T° B. ENOUGH HOT HOLDING EQUIPMENT IS NOT PRESENT, PROPERLY DESIGNED, MAINTAINED AND OPERATED TO KEEP HOT FOODS ABOVE 140°F
3. FOODS NOT PROTECTED FROM CONTAMINATION BY WORKERS. 14-1.10, 1.70, 1.71, 1.72, 1.80 A. FOOD WORKERS HANDLE FOODS WHEN ILL WITH A DISEASE TRANSMISSIBLE BY FOODS SUCH AS: DIARRHEA ("STOMACH FLU"), HEPATITIS, ACUTE RESPIRATORY INFECTIONS, VOMITING OR HAVE INFECTED CUTS OR BURNS ON THEIR HANDS B. FOOD WORKERS DO NOT WASH HANDS THOROUGHLY (GENERATE LATHER) AFTER VISITING THE TOILET, COUGHING, SNEEZING, SMOKING OR OTHERWISE CONTAMINATING THEIR HANDS C. FOOD WORKERS DO NOT USE PROPER UTENSILS (TONGS, SPOONS, SPATULAS, PLASTIC GLOVES) TO ELIMINATE UNNECESSARY HAND CONTACT WITH COOKED OR PREPARED FOODS		7. INADEQUATE COOKING AND REHEATING OF POTENTIALLY HAZARDOUS FOODS. 14-1.82, 1.83, 1.86 A. ALL POULTRY, POULTRY STUFFINGS, STUFFED MEATS AND STUFFINGS CONTAINING MEAT ARE NOT HEATED TO 165°F OR ABOVE, ACTUAL T° B. ALL PORK OR ANY FOOD CONTAINING PORK IS NOT HEATED TO 150°F OR ABOVE, ACTUAL T° C. OTHER POTENTIALLY HAZARDOUS FOODS REQUIRING COOKING ARE NOT HEATED TO 140°F OR ABOVE BEFORE THEY ARE PLACED IN HOT HOLDING EQUIPMENT. (EXCEPTION-RARE ROAST BEEF OR RARE BEEF FROM SOLID CUTS MAY BE SERVED AT 130°F OR ABOVE.) ACTUAL T° D. POTENTIALLY HAZARDOUS FOODS THAT HAVE BEEN COOKED AND THEN REFRIGERATED, ARE NOT RAPIDLY REHEATED TO 165°F OR ABOVE. (STEAM TABLES, BAIN-MARIES, WARMERS, CROCKPOTS AND SIMILAR HOT HOLDING FACILITIES, ARE BEING USED FOR REHEATING) E. FROZEN FOODS LARGER THAN THREE POUNDS ARE BEING COOKED FROZEN OR PARTIALLY THAWED OUT
4. FOODS NOT PROTECTED FROM CONTAMINATION BY OTHER SOURCES. 14-1.10, 1.31, 1.40, 1.80, 1.90, 1.91, 1.92, 1.100 A. TOXIC CHEMICALS ARE IMPROPERLY LABELED, STORED, OR USED SO THAT CONTAMINATION OF FOOD CAN OCCUR B. ACID FOODS ARE STORED IN CONTAINERS OR PIPES THAT CONSIST OF TOXIC METALS (ANTIMONY, CADMIUM, COPPER, ZINC, LEAD) C. FOODS OR FOOD AREA/PUBLIC AREA CONTAMINATED BY SEWAGE, OR DRIPPAGE FROM WASTE LINES		* IMMINENT HEALTH HAZARD - REFER TO 10 NYCRR 14-1.10 ** NUMBERS LISTED REFER TO NYCRR 14-1

PART 2 – ESTABLISHMENT SANITATION, DESIGN AND MAINTENANCE

8. FOOD NOT PROTECTED IN GENERAL. 14-1.40 THRU 1.45, 1.50, 1.80, 1.81, 1.85, 1.86, 1.87, 1.88, 1.97, 1.100, 1.110, 1.180** A. FOOD NOT PROTECTED DURING STORAGE, PREPARATION, DISPLAY, TRANSPORTATION, AND SERVICE FROM POTENTIAL SOURCES OF CONTAMINATION (EX: FOOD UNCOVERED, MISLABELED, STORED ON FLOOR, MISSING OR INADEQUATE SNEEZE GUARDS, FOOD CONTAINERS DOUBLE STACKED) B. IN USE FOOD DISPENSING UTENSILS IMPROPERLY STORED C. IMPROPER HANDLING AND STORAGE OF CLEAN, SANITIZED EQUIPMENT AND UTENSILS D. SINGLE SERVICE ITEMS REUSED, IMPROPERLY STORED, DISPENSED, NOT USED WHEN REQUIRED E. ACCURATE THERMOMETERS NOT AVAILABLE OR USED TO EVALUATE HOT HOLDING, COOKING, REHEATING, AND REFRIGERATED STORAGE TEMPERATURES F. IMPROPER THAWING PROCEDURES USED G. RAW FOODS NOT PROPERLY WASHED PRIOR TO SERVING		12. IMPROPER SANITARY FACILITIES AND CONTROLS. 14-1.10, 1.130, 1.140 THRU 1.143 A. HOT, COLD RUNNING WATER NOT PROVIDED, PRESSURE INADEQUATE B. IMPROPERLY FUNCTIONING ON-SITE SEWAGE DISPOSAL SYSTEM, IMPROPER/UNAPPROVED MUNICIPAL SEWER CONNECTION C. PLUMBING AND SINKS NOT PROPERLY SIZED, INSTALLED, MAINTAINED; EQUIPMENT AND FLOORS NOT PROPERLY DRAINED D. TOILET FACILITIES INADEQUATE, INCONVENIENT, DIRTY, IN DISREPAIR, TOILET PAPER MISSING, NOT SELF-CLOSING DOORS, MISSING HAND WASH SIGNS E. HANDWASHING FACILITIES INACCESSIBLE, IMPROPERLY LOCATED, DIRTY, IN DISREPAIR, IMPROPER FIXTURES, SOAP AND SINGLE SERVICE TOWELS OR HAND DRYING DEVICES MISSING
9. POOR HYGIENE AND ACTIVITIES OF FOOD WORKERS. 14-1.71, 1.72, 1.176, 1.177 A. INADEQUATE PERSONAL CLEANLINESS B. TOBACCO IS USED; EATING, DRINKING IN FOOD PREPARATION, DISHWASHING, FOOD STORAGE AREAS C. HAIR IS IMPROPERLY RESTRAINED D. DRESSING ROOMS DIRTY, NOT PROVIDED, IMPROPERLY LOCATED		13. IMPROPER GARBAGE AND RUBBISH DISPOSAL. 14-1.150 A. ADEQUATE LEAKPROOF, NON-ABSORBENT, VERMIN-PROOF, COVERED CONTAINERS NOT PROVIDED WHERE NEEDED B. GARBAGE STORAGE AREAS NOT PROPERLY CONSTRUCTED, INCINERATORS, FOOD WASTE GRINDERS OR COMPACTORS DIRTY AND CREATING A NUISANCE
10. POOR SANITARY DESIGN, CONSTRUCTION, INSTALLATION OF EQUIPMENT AND UTENSILS. 14-1.90 THRU 1.96, 1.100, 1.101, 1.102 A. FOOD (ICE) CONTACT SURFACES ARE IMPROPERLY DESIGNED, CONSTRUCTED, INSTALLED, LOCATED (CRACKS, OPEN SEAMS, PITTED SURFACES, TIN CANS REUSED, UNCLEANABLE OR CORRODED FOOD CONTACT SURFACES) B. NON-FOOD CONTACT SURFACES AND EQUIPMENT ARE IMPROPERLY DESIGNED, CONSTRUCTED, INSTALLED, MAINTAINED (EQUIPMENT NOT READILY ACCESSIBLE FOR CLEANING, SURFACES NOT SMOOTH FINISH)		14. INADEQUATE INSECT/RODENT CONTROL. 14-1.40, 1.60, 1.160 A. INSECTS, RODENTS, PRESENT B. EFFECTIVE MEASURES NOT USED TO CONTROL ENTRANCE (RODENT, INSECT PROOF CONSTRUCTION), HARBORAGE AREAS AVAILABLE FOR RODENTS, INSECTS AND OTHER VERMIN C. PESTICIDE APPLICATION NOT SUPERVISED BY A CERTIFIED APPLICATOR/IN ACCORDANCE WITH LABEL DIRECTIONS/IN ACCORDANCE WITH APPLICABLE LAWS
11. IMPROPER CLEANING, WASHING AND SANITIZING OF EQUIPMENT AND UTENSILS. 14-1.110 THRU 1.117 A. WASH/RINSE WATER DIRTY, IMPROPER TEMPERATURE B. SANITIZING RINSE SOLUTIONS AT IMPROPER TEMPERATURE, CHEMICAL CONCENTRATION; IMMERSION TIME TOO SHORT; HAND DISHWASHING TECHNIQUE INCORRECT C. ACCURATE THERMOMETERS, CHEMICAL TEST KITS, PRESSURE GAUGE COCKS ARE NOT PRESENT OR INOPERATIVE TO MONITOR DISHWASHING AND SANITIZING OPERATIONS D. WIPING CLOTHS DIRTY, NOT STORED PROPERLY IN SANITIZING SOLUTIONS E. FOOD CONTACT SURFACES NOT WASHED, RINSED, AND SANITIZED AFTER EACH USE AND FOLLOWING ANY TIME OF OPERATIONS WHEN CONTAMINATION MAY HAVE OCCURRED F. NON-FOOD CONTACT SURFACES OF EQUIPMENT NOT CLEAN		15. IMPROPER CONSTRUCTION AND MAINTENANCE OF PHYSICAL FACILITIES. 14-1.88, 14-1.170 THRU 1.175, 1.180, 1.181, 1.182, 1.183 A. FLOORS, WALLS, CEILINGS, NOT SMOOTH, PROPERLY CONSTRUCTED, IN DISREPAIR, DIRTY SURFACES B. LIGHTING AND VENTILATION INADEQUATE, FIXTURES NOT SHIELDED, DIRTY VENTILATION HOODS, DUCTWORK, FILTERS, EXHAUST FANS C. PREMISES LITTERED, UNNECESSARY EQUIPMENT AND ARTICLES PRESENT, LIVING QUARTERS NOT COMPLETELY SEPARATED FROM FOOD SERVICE OPERATIONS, LIVE ANIMALS, BIRDS AND PETS NOT EXCLUDED D. IMPROPER STORAGE OF CLEANING EQUIPMENT, LINENS, LAUNDRY UNACCEPTABLE
		16. MISCELLANEOUS, ECONOMIC VIOLATION, CHOKING POSTER, TRAINING. 14-1.73, 1.190 ** NUMBERS LISTED REFER TO 10 NYCRR 14-1

FIGURE 7

STATE OF BAHRAIN
MINISTRY OF HEALTH

DIRECTORATE OF PUBLIC HEALTH
FOOD HYGIENE SECTION

FOOD SERVICE ESTABLISHMENT INSPECTION FORM

1. Name of Est. _____ 2. Name of Owner/manager. _____

3. Ad. _____

4. No. of Est. 5. Lane 6. Road

7. Avenue 8. Highway 9. Block

10. Type of Est. 11. Regist No. 12. Inspector's No.

13. Date of Insp. 14. Purpose of Visit

15. Time of Insp. From To. 16. Article

17. Compliance Date 18. Other Results.

The items with (2) in front of them are considered as health hazards and do not comply with Public Health Law. Kindly correct them within a period of _____ from today's date _____, otherwise we will have to apply article _____ of the Public Health Law No. 3 for 1975 and which states _____

Satisfactory ☐ Unsatisfactory ☐ Not applicable ☐

A. Operational Procedures		*11. No cooked foods processed on the same equipment or stored in the same container that has previously been used for raw foods. ☐	
1. Establishment is registered with the Directorate of P.H.	☐	Disease Control and Personal Hygiene	
<u>Cooling Practices</u>	61	12. Valid Health Certificate is available for all foodhandlers	☐
2. Raw chilled meats, poultry and fish are stored at 7°C or below	☐	*13. Persons with skin lesions are not allowed to handle foods	☐
3. Frozen foods are stored at -10°C or below	☐	14. Food handlers habits and cleanliness are acceptable	☐
*4. Cooked potentially hazardous foods are stored at 7°C or below	☐	15. Foodhandlers wash hands after defecation and after handling raw meats and raw poultry	☐
*5. The depth of cooked potentially hazardous foods stored in containers in refrigerators is 10 cm or less	☐	16. Foodhandlers wear aprons and cover their head while working	☐
6. Cold storage equipped with thermometer	☐	<u>Cleanliness of Utensils, Equipment and Work Surfaces</u>	
<u>Hot Holding</u>	66	*17. Food utensils properly washed, sanitized and stored	☐
*7. Foods are properly cooked	☐	*18. Food contact surfaces or equipment and work surfaces properly washed and disinfected	☐
*8. Potentially hazardous foods which are kept hot are at 60°C or more	☐	<u>Water Supply</u>	
*9. Leftover foods which are potentially hazardous are reheated to 75°C or above	☐	*19. Water and ice from safe and approved source	☐
*10. No direct contact of raw foods of animal origin with cooked food	☐	20. Water and ice properly stored	☐
	70		80

FIGURE 7 (Continued)

INSPECTION FORM (CONTINUED)

21. Ice handled in a sanitary manner	☐	32. Screened doors are self closing	☐
<u>Fresh Fruits and Vegetables</u>	81		92
22. Fruits and vegetables properly washed	☐	33. Tables and closets with formica tops are provided and installed at least 30 cm from ground level	☐
	82		93
23. Fresh Fruits and vegetables properly disinfected	☐	34. Water heater in working condition is available	☐
	83		94
<u>D. Physical Facilities, Maintenance & General Cleanliness</u>		35. Stainless steel sinks connected to a drain and the presence of a floor drain	☐
			95
24. Separation of the kitchen area from the dining room area	☐	36. Clean bags used for packing food	☐
	84		96
25. Separation of the preparation area from the cooking area	☐	37. Food utensils are not rusty or cracked	☐
	85		97
26. Walls are covered with white tile upto 2m from floor and the rest are painted with washable oil paint.	☐	38. Separate storage with shelves one foot above the ground level are provided	☐
	86		98
27. The floors are covered with tiles	☐	39. Detergents and disinfectants are properly used and are stored away from food	☐
	87		99
28. Lighting and ventilation adequate	☐	40. The establishment is free from insects and rodents	☐
	88		100
29. Exhaust fan is present	☐	41. A clean and covered refuse container(s) is available	☐
	89		101
30. Screening of door and windows	☐	42. Establishment is clean in general	☐
	90		102
31. Availability of electric fly traps	☐		
	91		

You are kindly asked to pay attention to the following:

Signature of Manager/Owner

Signature of Inspector

* Require immediate action (Critical Items)

20th December, 1981
H/sg.

The critical items in the inspection form used in Bahrain (Figure 7) are similar to the critical items in the New York inspection form (Figure 6) and pointed out in reference 13. This approach is an advantage over the Georgia inspection form because Bahrain's inspection form emphasized critical items that the New York form emphasizes.

Bryan (20) has indicated that the procedure for HACCP includes the examination of food service establishments to:

- (1) identify potentially hazardous food items and critical ingredients that contain poisonous substances, microorganisms or that can support microbial growth;
- (2) locate sources and specific points of contamination by observing each step of the operation;
- (3) determine the potential for microorganisms to survive a heat process; and
- (4) determine the potential for the organisms to multiply at room temperature and during hot and cold storage.

According to Bryan (19, 20), the first step of a hazard analysis is to talk with the manager and the workers concerning the potentially hazardous foods, the way they are usually received, stored, thawed, handled before and after cooking, retained hot,

cooled, reheated, handled after reheating, and served. Based on these observations and based on some tests (time/temperature exposure, pH, water activity), critical control points can be identified and the proper prevention and control measures applied. Both the health inspector and the manager should establish a procedure to monitor critical control points continuously or periodically, as applicable. If the monitoring detects that the process is out of control, management should have a plan of action to immediately correct the defect (21). Monitoring may involve taking temperature measurements, collecting samples, performing chemical, physical or microbiological tests, or it may involve only observations or visual inspection.

Cross-contamination and time temperature exposure might be the major hazards in Bahrain. This assumption is based on the following observations: raw poultry and raw meat, both of which frequently harbor Salmonella, are roasted between the hours of 4:00 PM and midnight. Inspectors, do not usually work during this period since regular working hours are from 6:00 AM to 1:00 PM. Chickens are roasted in a rotisserie. Some of these chickens might be sold to the consumer before their internal temperature is high enough to kill Salmonella. In addition, cross-contamination might also occur, especially when

cooked chicken is left in the bottom of the rotisserie for hot-holding, and raw chickens on the bar leak their juices (which can be contaminated) on the cooked chickens. Temperature failure or cross-contamination thus are two important hazards and cooking and holding of cooked products are critical control points, which, if not properly controlled, will result in survival, contamination, and growth of the microorganisms. Cross-contamination is also a problem in restaurants that serve barbecued foods. For example, food handlers use their bare hands when they put raw meat (ground and pieces) on the skewers. Their hands can become contaminated with pathogenic microorganisms. Consequently, pathogens might reach cooked foods if the same people are involved in serving. Also, pathogens might reach the cloths and sponges used for wiping plates, spoons, knives and forks; the result can be the contamination of these items too.

Qualified personnel must identify those potential or actual hazards, and must detect sources and modes of contamination. Having identified the critical control points, managers and staff must be trained to apply specific control measures, for each faulty operation and to apply proper methods for monitoring control measures at the critical control points. Qualified inspectors or supervisors should evaluate monitoring systems and detect new or missed critical

control points (19, 66, 68).

Some selected hazards, critical control points, and monitoring procedures that might be applicable to the situation in Bahrain are shown in Table 10; more detailed data are given by Bryan (22) and Munce (56).

HACCP is a procedure that, if properly applied, would greatly increase the effectiveness of the food safety program and the efficiency of the health manpower (68). Most important, it would enhance safety. It is a rational method of foodborne disease control that focuses attention on those points that directly effect the safety and quality of food. It offers a rational approach to microbiological control by placing more emphasis on areas where mishandling of food products is most likely to occur (68). HACCP determines the exact points in the food operation that are critical to the safety of the product (5, 19, 20, 21, 22, 39, 46, 50, 56, 66, 68, 74). If these critical control points are not controlled properly, the result may be foodborne illness (46).

HACCP is an approach that can be applied to all points in the food chain (3, 5, 19, 39, 46, 50, 56, 66, 68, 74). The importance of this approach is that it addresses the factors that contribute to foodborne disease outbreaks. These factors are often neglected or not emphasized by the traditional type of inspection.

TABLE 10

TABLE 10 Hazards, Critical Control Points, Preventive Measures and Monitoring Procedures of Food Service Operations

Operational Steps ^a	Hazards	Practice or Procedures ^b	Relative Importance ^c	Preventive Measures	Monitoring Procedure
Purchasing and Receiving	Pathogens on raw foods or ingredients	Incoming food	*	Separate raw - and cooked - food operations and foods	Probably none practicable because many raw foods are contaminated with a variety of foodborne pathogens
Preprocessing	First step of cross-contamination; workers' hands and clothing become contaminated with foodborne pathogens	Handling of raw foods of animal origin	**	Wash hands after handling raw foods of animal origin	Observation: Look to see whether workers wash their hands after handling raw foods of animal origin (raw meat, raw, poultry, raw fish or egg shells) Microbiological testing: sample workers' hands and test rinses or swabs for pathogens.
	First step of cross-contamination; equipment and utensil surfaces become contaminated with foodborne pathogens	Equipment surfaces that contact raw foods	**	Clean and disinfect utensils and equipment, separate raw food areas operations from cooked food areas and operations	Observation: observe flow of raw foods to see if they go into areas used for cooked foods, look, to see whether equipment and utensils (e.g., cutting boards, table tops, grinders, slicers, knives, cleavers) used for raw foods are washed and disinfected after use, before use for other foods.

a. Critical control point

b. Practices or procedures that require monitoring at critical control point

c. Relative risks

TABLE 10 (Continued)

Operational Steps ^a	Hazards	Practice or Procedures ^b	Relative Importance ^c	Preventive Measures	Monitoring Procedure
	First step of cross-contamination; rags and sponges become contaminated with foodborne pathogens	Rags and sponges used to process raw food preparation areas	**	Use separate sponges, rags, cloths in raw food areas from those used in cooked food areas	<u>Microbiological testing:</u> Sample equipment surfaces with rodac (replicate organism detection and counting) contact plates or swabs and test for pathogens, fecal indicator organisms, or aerobic plate count. <u>Observation:</u> Observe pattern of use of sponges, rags, and cloths that are used to wipe equipment and surfaces or any area where raw foods are processed.
Cooking	Survival of pathogens because of inadequate cooking (internal temperature exposure fails to kill pathogens)	Temperature of food at completion of cooking or at completion of post area rise period	**	Cook potentially contaminated foods thoroughly; eat cooked food immediately after cooking	<u>Measurement:</u> Insert thermometer into geometric center of poultry and meat products upon removal from oven and leave in center until temperature rise begins to decline. Beef surfaces and poultry surfaces should reach 74° (165°F). If temperature reaches 72° (160°F) or higher, there is no need to collect samples of such foods for microbiological testing at this step of operation.

TABLE 10 (Continued)

Operational Steps ^a	Hazards	Practice or Procedures ^b	Relative Importance ^c	Preventive Measures	Monitoring Procedure
Handling cooked foods	Contaminated by workers during handling	Cooked foods during preparing, slicing, cutting, grinding, chopping or otherwise handling or while in contact with equipment	***	Do not touch cooked foods; use utensils to handle cooked foods	<u>Observation:</u> Observe whether cooked foods are touched by workers of if poor personal hygiene or other poor food handling practices might subject subject foods to contamination. <u>Microbiological testing:</u> Sample foods and test them for quantity of coagulose - positive staphylococcia <u>Escherichis coli.</u>
	Cross-contamination from foods of animal origin (via equipment, utensils, cleaning, rags or hands).	Cooked foods during handling and preparing	***	Use cleaned and sanitized utensils or equipment to process, hold, or handle cooked foods	<u>Observation:</u> Look for possible routes of cross-contamination from raw foods of animal origin to cooked foods. <u>Microbiological testing:</u> Sample foods and test them for <u>E. coli</u> or <u>Salmonella.</u>
Workers and managers	Poor operational procedures leading to contaminated of foods and survival or growth of foodborne pathogens in foods.	Procedures performed	*****	Train and give certificates to managers and supervisors; train and supervise food workers.	<u>Observation:</u> Look for operations that contribute to foodborne diseases and for poor sanitation practices. <u>Measurement:</u> Test trainees at completion of training; inspect for changes in operational procedures before and after training.

TABLE 10 (Continued)

Operational Steps ^a	Hazards	Practice or Procedures ^b	Relative Importance ^c	Preventive Measures	Monitoring Procedure
	Contamination of foods by workers	Disease control of worker	****	Do not work when ill with diarrhea or colds or when infected with lesions containing pus.	Observation: Observe whether workers work when they have diarrhea, colds, or infected lesions.
	Contamination of foods by workers	Personal hygiene practice of workers	**	Practice good personal hygiene.	Observation: Observe personal hygiene practice and ways foods are handled and whether hands are washed before beginning work, after going to the toilet, after touching raw meat, after coughing or sneezing.

Source: Selected from Bryan: (22) 1982.

In their meeting on HACCP, the World Health Organization (WHO) and the International Commission of Microbiological Specification for Foods (ICMSF) recommended the application of HACCP in the developing and the developed countries (74).

Lani (a), Dinda (b), and Bills (c), (personnel familiar with HACCP in New York), contended that HACCP is the most rational method to control salmonellosis and other foodborne diseases because it provides education along with inspection. At the same time, it is a very good learning experience for health sanitarians. It gives them an understanding of what is actually happening in the food establishments. Lani, Bills, and Dinda also stated that the only problem associated with HACCP is that the initial inspection requires a lot of time. Each inspector spends between 7 and 16 hours in one restaurant. Subsequently, however, the verification that the system is working takes very little time. Time is a

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- (a) Daniel Lani: Senior public health sanitarian and training officer of HACCP Personnel, Suffolk, Department of Health Services, N.Y., Tel. (516)360-3000.
 - (b) Ernst Dinda: Associate public health sanitarian, supervisor for the food control for the County of Suffolk, N.Y., Tel. (516)348-2783.
 - (b) Richard Bills: Principal sanitarian in food protection section, foodborne disease surveillance and implementation of HACCP Program, State Department of Health, Albany, N.Y., Tel.(518)474-3291.

problem only in the beginning; once the inspector collects the information about food operations, there is no need to spend that much time again.

VIII. Recommendations

A. In Bahrain, HACCP should gradually replace the traditional health inspection of food service establishments. This recommendation is based on the following facts:

1. Salmonellosis is a foodborne disease still highly prevalent in Bahrain, despite eight inspections a year and health examination of workers.
2. Many potentially hazardous food items (meat, poultry, eggs, dairy products) are imported and some others are produced locally. Some of these foods are contaminated with Salmonella upon arrival or at site of production in Bahrain; this is particularly true of raw meat and poultry.
3. Traditional health inspection of such food items in the ports and in the food service establishments has not provided, and cannot provide, assurance of freedom from contamination.
4. Traditional health inspection does not constitute scientific approach and lacks specificity for controlling salmonellosis and other food-borne diseases.

5. HACCP is applicable for all foodborne diseases organisms, spoilage organisms, or any hazards that occur from or to a food.
6. HACCP is a rational approach. It places emphasis on factors most often responsible for foodborne illness. As a result, it assures microbiological safety and quality of food not achievable by traditional inspection.
7. HACCP would greatly increase the efficiency and effectiveness of the health inspector's operations in the control of salmonellosis and other foodborne diseases.
8. HACCP is applicable everywhere (at homes, restaurants, food establishments), and it is an appropriate control measure for all foodborne hazards.
9. HACCP is a good educational experience for both the inspector and the food operator.
10. HACCP has been successfully applied by different industries and by the Department of Health Services in New York and elsewhere as a substitute for traditional inspection in restaurants.
11. The World Health Organization (WHO), United States Department of Agriculture (USDA), International Commission on Microbiological specification for foods (ICMSF), Food Safety and Inspection Service (FSIS), and some professionals

have recommended HACCP as an important component of a food safety program.

A HACCP program should be applied gradually. For example, it could be phased in on one island first and then compare factors that contribute to salmonellosis on this island with those on the other islands after two or three years. Or, one could identify some high risk establishments and apply HACCP there. In Bahrain, most of the food establishments are operated by Indians. For this reason, the meals, the ingredients, and typical operation do not vary much from one restaurant to another. As a result, the types of hazards and their critical control points will be similar in many restaurants. Consequently, it should be sufficient to apply HACCP for approximately 20% of these restaurants and use the same monitoring procedure for other restaurants with similar operations.

B. Provide training for the health personnel and the food operators

1. Train the health personnel (mainly the inspectors and supervisors) on elements and application of HACCP as soon as possible. Senior inspectors should be trained first by a WHO consultant in the HACCP*. The persons who do the hazard analysis should have considerable expertise in food microbiology, food technology, and know the

process of food preparation. Training should include such topics as food microbiology, pH, temperature, a_w , foodborne pathogens, food processing and operations, sampling, and then the elements of HACCP. Proper measuring equipment -- such as thermo-meters and water activity and pH meters -- must be purchased and the inspectors trained in how to use it. The type of temperature-measuring device is very important.

2. Food establishments operators should be trained primarily to reach an understanding of the factors that contribute to the outbreaks of foodborne diseases and the conditions at which microorganisms contaminate, survive and/or grow in or on food. Food establishment operators

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2. F. Leo Kauffman: Division of Food Technology, Bureau of Foods, Food & Drug Administration, Washington, D.C., 20204, U.S.A.
3. Howard E. Bauman: Science and Technology, The Pillsbury Co., 608 Second Avenue, S., Minneapolis, Minn. 55402, U.S.A.
4. Barbara S. Bobeng: Department of Institution Management, Iowa State University, Ames IA 50011, U.S.A.
5. B.A. Maunce: Qantas Airways Ltd., Qantas Jet Base, Mascot, NSW 2020.
6. Keith Ito: National Food Processors Association, 1950 Sixth Street, Berkeley, CA 94710, U.S.A.

also should be trained to prevent factors that lead to outbreaks of foodborne illness and to apply proper control measures and set procedures to monitor these control measures.

C. Epidemiological surveillance must be established to:

(1) collect data on the incidence of salmonellosis and other foodborne diseases in Bahrain each year; (2) identify the main food items involved in the outbreaks of foodborne diseases, and (3) identify the factors that contribute to the outbreaks of those diseases in Bahrain.

D. Further studies should be conducted to determine the effect of HACCP on the control of salmonellosis in particular and other foodborne diseases in general.

IX. Summary and Conclusions

This descriptive study, analyzes and compares the traditional food inspection and a proposed HACCP approach to food safety. The study is based on a review of literature, personal communication with professionals in foodborne diseases and food inspection, and field visits to some local health departments in the Atlanta metropolitan area.

Traditional health inspection does not emphasize factors that contribute to outbreaks of salmonellosis and other foodborne diseases. As a result, the traditional approach will not assure microbiological safety and

quality of food. On the other hand, the HACCP approach is the most rational method of controlling salmonellosis and other foodborne diseases because it deals with the specific factors that contribute to outbreaks of those diseases. This approach should gradually replace traditional health inspection in Bahrain and elsewhere to control hazards resulting from contaminated food.

The procedure should be phased in gradually in each part of the food chain and in each restaurant in Bahrain.

Hazards must be identified, risk must be assessed and procedures at critical control points monitored by health inspectors who are fully trained in the HACCP concept. This approach will not only protect the public from salmonellosis and other foodborne diseases and the reputation of food establishments, but it also will protect the name of Bahrain.

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