

AN ABSTRACT OF THE THESIS OF

Maria F. Morales R. for the degree of Master of Science
in Nutrition and Food Management presented on August 23, 1993.
Title: Hazard Analysis and Critical Control Point System for Home
Prepared Foods as a Basis for Adult Education in Urban
Guayaquil, Ecuador

Abstract approved: _____
Margy Woodburn, Ph.D.

The Hazard Analysis and Critical Control Point (HACCP) system for studying the food preparation process was conducted in four households in an environmentally poor urban neighborhood of Guayaquil, Ecuador. The analysis consisted of observing all of the steps in the food preparation process, measuring food temperatures at each step, and collecting food and water samples. Food and water samples were tested for total aerobic microorganisms, molds and yeast, total coliforms, and fecal coliforms. Temperatures reached during the cooking process were high enough to kill vegetative forms of foodborne pathogens; however, heat-resistant spores could have survived. Leftover food was held at room temperature for long periods of time which allowed multiplication of vegetative forms from spores or from contaminated food utensils. Leftover food was eaten either cold or reheated to warm temperatures. Water samples were taken from water delivery trucks and from each family. Water was identified as one of the main hazards in food preparation. None of the water

samples met the criteria of the Ecuadorean National Institute of Standards for human consumption. Fecal samples were taken from children in the families, and were analyzed for parasites. Parasites were found in all of the samples. After critical control points were identified, appropriate interventions were taken to improve safety at each step.

Based on these HACCP observations, a food and water safety program was designed and taught to five mothers attending a Guayaquil Child Care Center. The program included a lesson on each of four topics: food and water safety, parasites, care during diarrhea with emphasis on oral rehydration therapy and the introduction of solid food, and nutrition. A control mother was identified for each group. Diarrhea occurred in children of both groups but none of the children was hospitalized. With the exception of nutrition concepts, the knowledge about food and water safety concepts, parasites and care during diarrhea were well understood by both groups. This was reflected in positive changes in families' behavior toward using improved food and water sanitation practices as observed during a visit to each family which followed the HACCP study and the educational program.

Hazard Analysis and Critical Control Point System for Home Prepared Foods as
a Basis for Adult Education in Urban Guayaquil, Ecuador

by

Maria F. Morales R.

A THESIS

submitted to

Oregon State University

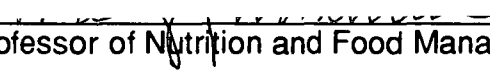
in partial fulfillment of
the requirements for the
degree of

Master of Science

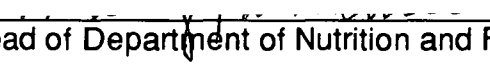
Completed August 23, 1993

Commencement June 1994

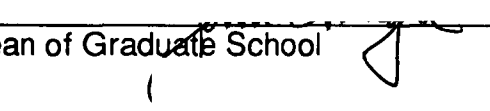
APPROVED:



Professor of Nutrition and Food Management in charge of major



Head of Department of Nutrition and Food Management



Dean of Graduate School

Date thesis is presented August 23, 1993

Typed by Maria F. Morales R.

ACKNOWLEDGMENTS

Appreciation is given to Dr. Gina Quiñonez, Dr. Gloria Bajaña, Dr. Luis Serrano, and doctors of the Department of Food Microbiology of the National Hygiene Institute for their consulting in this study. Appreciation is extended to Norma Nevárez, leader of the cooperative "La Paz"; to the family members of the households where the HACCP study was applied; to Orfilia Auz, head of the child care center, and to the mothers to whom the program was taught for their assistance and cooperation. My especial appreciation to Dr. Margy Woodburn, head of the Nutrition and Food Management Department of Oregon State University, for advising me during the application of the program and conducting the preparation of this thesis. My appreciation is also extended to the committee members for their recommendations for this study. My deepest thanks to the person who always was close to me during this study; even though she was not with me physically, I knew I was in her brain and in her heart: for my mother my eternal thanks and all of my love.

TABLE OF CONTENTS

	<u>Page</u>
I. INTRODUCTION	1
II. REVIEW OF LITERATURE	10
III. MATERIALS AND METHODS	29
IV. RESULTS AND DISCUSSION	43
V. SUMMARY	85
VI. BIBLIOGRAPHY	89
VII. APPENDICES	94

LIST OF FIGURES

<u>Figure</u>		<u>Page</u>
1.	Preparation of tuna soup in household of Guayaquil urban family 1.	73
2.	Preparation of tuna salad with potatoes in household of Guayaquil urban family1.	74
3.	Preparation of bean soup with vegetables in household of Guayaquil urban family 2.	75
4.	Preparation of oat gruel as a mid-morning refreshment for children in household of family 2.	76
5.	Preparation of meat stew with lentils in household of Guayaquil urban family 3.	77
6.	Preparation of meat stew with potatoes in household of Guayaquil urban family 4.	78
7.	Critical control points of boiled water.	79

LIST OF TABLES

<u>Table</u>	<u>Page</u>
1. Population changes in Ecuador 1950 and 1990.	8
2. Mortality rates of infants and children in Ecuador during 1987 and 1989.	9
3. Main diarrhea-causing agents in developing countries.	27
4. Parasite treatments recommended for children and adults.	28
5. Temperature and time information for critical control points for food during the cooking processes.	80
6. Aerobic total counts and molds and yeasts, total coliforms, and fecal coliforms in food cooked by urban families living in Guayaquil.	81
7. Results of testing for aerobic total count, total coliforms, and fecal coliforms in water samples from urban families living in Guayaquil.	82
8. Results of parasite analyses of young children in the HACCP-study families taken the last day of meetings and one month later.	83
9. Parasite analyses of stools of young children of the program mothers.	84

HAZARD ANALYSIS AND CRITICAL CONTROL POINT SYSTEM FOR HOME PREPARED FOODS AS A BASIS FOR ADULT EDUCATION IN URBAN GUAYAQUIL, ECUADOR

I. INTRODUCTION

Food and water quality are a major concern in developing areas. In 1986, the World Health Organization and the Food and Agriculture Organization emphasized that the Hazard Analysis Critical Control Point system is applicable to evaluating food safety in homes. This system is generally applied to food processing systems at the industrial or institutional level. However, the household must also be a focal area, both in analysis and application. The HACCP system was used in this study in urban households in Guayaquil, Ecuador in order to identify the greater risks for unsafe food and water and the corrective measures needed, based on observations of the food preparation process, microbiological tests of food and water, and evaluation of children for intestinal parasites.

In the last two decades, Ecuador, whose population was 10,236,000 in 1990 and projected to be 11,493,000 in 1995, has experienced a constant flow of people within the same country. The rural people have migrated to the big cities, causing one of the biggest problems in the last twenty years, urbanization. Since 1940, Ecuador changed from a rural to an urban country (Table 1). From these data, the percentage of rural people who came to the cities cannot be known, but it can be said that there was a decrease in the percentage of people living in rural areas. The fertility rate and the mortality rate overall in the big cities have decreased, so the resulting natural increase was relatively low. In rural areas, the capitalization process and the availability of credit to the small and medium sized farmers have been faulty. Thus, farmers are being pushed to the cities because of a lack of economic resources and tools and agricultural

machinery, that are needed to cultivate the better quality land. In addition, Ecuadorian rural areas are characterized by a deficient infrastructure; they lack schools, medical care centers, water supply, electrical energy, transportation and appropriate systems of communication, such as highways and roads. These also are pushing factors which have caused country people to migrate to cities.

The accelerated rural to urban flow of people has changed geographic, economic, political, social, and cultural characteristics; not just in the places where they came from but also, where they have settled. Urbanization, which has occurred before industrial development, has created the following difficulties:

- The abandonment of agricultural activity has affected the production level and the overall national market of products.
- The qualifications of the laborers seeking work are not always those required by the different economic sectors of the city.
- The supply of laborers is greater than the demand of industries which are functioning or which are going to be built .
- The unemployment rate has increased in the cities.
- The underemployment rate has increased significantly, and the people who have migrated to the cities are working in low paying activities.
- The "suburbios", where people have built their houses by invading land located on the peripheral areas of the big cities, have increased.
- The condition of housing in the cities is not what rural people wished; there is a deficit of houses with basic services, which has resulted in problems of crowding.
- The urban infrastructure has not been prepared for this enormous population increase, which has aggravated the insufficiency of basic services, including water and sewage systems (Centro de Estudios de Poblaciòn y Paternidad Responsable, 1986).

- Poverty has increased. According to the UNICEF in 1992 more than 60% of Ecuadorean families lived under the level of critical poverty. There are 140,000 adolescents under 14 years old who work, and there are 300,000 young people under 19 years old who work at low wages (El Universo, Nov. 1992).
- The adjustment of migrants to city customs and food habits is difficult.

From 1987- 1989, infant mortality in Ecuador has decreased (Centro de Estudios de Poblaciòn y Paternidad Responsable, 1992). However, these rates are still very high if compared to developed countries (Japan: 5 infants died per 1000 live births in 1990) (Table 2). Even though the decrease in infant mortality rate has been considerable, some infectious illnesses, such as diarrhea, are very difficult to reduce due to bad sanitation systems, low nutrition levels, and poor standards of living (Centro de Estudios de Poblaciòn y Paternidad Responsable, 1990).

This study was conducted in Guayaquil, the capital of one of the Ecuadorean provinces, Guayas. Guayas had a population of 2,515,146 inhabitants in 1990, which was about 26% of the total Ecuadorean population (Instituto Ecuatoriano de Estadísticas y Censos, 1990). The following data show the increase of Guayas population, according to the five Censuses (Centro de Estudios de Poblaciòn y Paternidad Responsable, 1992):

1950:	582,144	inhabitants
1962:	979,223	inhabitants
1974:	1,512,333	inhabitants
1982:	2,038,454	inhabitants
1990:	2,515,146	inhabitants.

In just 40 years, the Guayas' population has increased four times. This province is one of the greatest receptors of migrated people, along with the province of Pichincha where Quito, the national capital, is.

The province of Guayas has the following characteristics:

- In 1982, this province received 397,000 immigrants from the provinces around it.
- In 1990, it had a density of 122.7 inhabitants per Km², which is above the Ecuadorean average of 30 inhabitants per Km² (one of the highest in South America).
- In 1990, it had 512,664 houses built mainly from concrete, bricks and concrete blocks (66% of the houses). Wood was used for walls for 14% of the houses; tree and bush stems, for 19% of the houses. Zinc was the predominant material used as the roof. Concrete and boards were the main materials for the floor.
- The supply of potable water is a national problem. In the case of the Guayas province, the situation is very grave. Between 1982 and 1990, with the great population increase, this basic service only increased by 3.9%. Houses that had potable water from pipes increased from 52.7 % in 1982 to 56.6 % in 1990; 43.3% of the houses could not get water from water pipes (Instituto Nacional de Estadísticas y Censos, 1990) . In this province, 29.1 % of houses had to get water from other resources such as water delivery trucks in 1982 (Centro de Estudios de Población y Paternidad Responsable, 1987).
- In 1990, 49.5 % of the houses in the province of Guayas were connected to the public sewage system (Instituto Nacional de Estadísticas y Censos, 1990).

- For personal waste disposal, 64% of the houses in this province have their own plumbing, 7.8% have community toilets, 14.8% use latrines, and 13.4% of the houses did not have any sanitation system in 1990 (Instituto Nacional de Estadísticas y Censos, 1990).

The city of Guayaquil, where this research was done, has the following characteristics:

- In 1950, Guayaquil had 258,996 inhabitants; the population has increased about six times to 1,570,396 in 1990.
- In 1990, the population of Guayaquil was 62% of the population of the province. The density was 302.6 inhabitants per Km², higher than the total density of Guayas (Instituto Nacional Estadísticas y Censos, 1990).
- Guayaquil had an infant mortality rate of 20 per 1000 live births in 1990 (Instituto Nacional de Estadísticas y Censos, 1990).
- In 1990, the fertility rate was 2.9 children per women. Women without any formal instruction had a fertility rate of 5.4 children per mother; those with a high level of education, 1.3 children per mother.

Acute infections, including diarrhea as a result of lack of sanitation, are the most important health problems of children in developing areas. Reports from Latin American countries listed diarrhea as the primary cause of mortality in more than 20% of all recorded early childhood deaths (Brussow et al., 1992). In Ecuador, the main causes for mortality in children under 5 years old are diarrhea and respiratory illness, which represented about 47 % of deaths (El Universo, Dec. 1992). Approximately, 20.8% of those deaths were due to diarrhea and dehydration (Centro de Estudios de Población y Paternidad Responsable, 1990).

Studies done in developing countries have determined that intervention to improve food hygiene and better handling, preparation and storage of food can

reduce diarrhea morbidity and mortality among children (Esrey and Feachen, 1980). An approach to the prevention of foodborne illness that has been widely applied in the food industry is the Hazard Analysis Critical Control Point system. HACCP consists of the determination of hazards and risks at each point in food processing or preparation; identification and monitoring of the critical points; and implementation of appropriate and immediate corrective actions. Frank Bryan, consultant to the World Health Organization and Pan-American Health Organization, has applied the HACCP system to the action of preparing food in many countries, including Peruvians living in the Peruvian Sierra and in a new settlement in Lima. He watched all of the steps of food preparation and tested for foodborne microorganisms. The corrective measures identified as needed were taken in each step of the cooking process (Bryan et al., 1988 a and 1988 b).

In this thesis research, the Hazard Analysis Critical Control Point system was applied to the cooking processes in four Guayaquil families, living in a poor urban neighborhood of the city. The critical points were identified and analyzed in order to identify the corrective actions needed. Food and water samples were taken and tested microbiologically for total counts and total coliforms as well as fecal samples from the children were analyzed for parasites. After identifying the critical points and the corrective measures, meetings with the families were held to discuss the corrective actions that could be taken in each step of the cooking process and in the water system.

Based upon these observations, a food and water safety program was developed. These series of lessons were taught to a group of mothers coming to a Child Care Center. The emphasis was on food and water safety information. Based upon identified needs, oral rehydration therapy during diarrhea episodes, the introduction of diet after these episodes, and basic nutrition information were also included. After the presentations, the urban families and child care center

mothers were visited to assess whether or not the corrective measures and food and water safety program were applied and to identify obstacles to applying them.

Table 1. Population changes in Ecuador 1950 and 1990
(Centro de Estudios de Población y Paternidad Responsable, 1992)

Year	Total population	Urban population	%	Rural population	%
1950	3,200,000	914,000	28	2,289,000	71
1990	10,236,000	5,668,550	55	4,568,000	45

Table 2. Mortality rates of infants and children in Ecuador during 1987 and 1989 (Centro de Estudios de Poblaciòn y Paternidad Responsable, 1990 and Bread for the World Institute on Hunger and Development, 1993)

Year	Under 1 year (a)	Under 5 years (a)
1987	53 (b)	57 (b)
1989	37 (b) 57 (c)	48 (b) 184 (c)

(a) Rate per 1000 live births.

(b) Centro de Estudios de Poblaciòn y Paternidad Responsable, 1990.

(c) Bread for the World Institute on Hunger and Development, 1993.

II. REVIEW OF LITERATURE

Diarrhea is considered one of the major causes of morbidity and mortality of younger children in developing countries, where one-third of the population live in houses that lack potable water and sewage system. One estimate is that the urban population in these countries will have 2.2 billion individuals by the year 2000. This will constitute 57% of the total population by 2025, creating favorable conditions for transmission of diarrhea causing pathogens (Crompton and Savioli, 1993). Over one-third of all deaths of children under five years are diarrhea-related in the developing areas. Even more surprising is the fact that 60% of those deaths are due to dehydration, which could be prevented through timely intervention with oral rehydration therapy (US Agency for International Development, 1985-1990).

Guayaquil is the largest Ecuadorean city, having about 2,515,000 people, which represented about 26% of the total Ecuadorean population, and has a density of 302.6 people per Km². Guayaquil is considered one of the cities most affected by urbanization, since only 56.6% of the houses in the province of Guayas, where Guayaquil is located, obtained potable water from pipes in 1990; and, only 49.5% of them were connected to the public sewage system (Instituto Nacional de Estadísticas y Censos, 1990). In Ecuador, thirty-seven children under 1 year old died per 1000 live births, and 48 children under 5 years died per 1000 live births (Centro de Estudios de Población y Paternidad Responsable, 1990). Guayaquil had an infant mortality of 20 per 1000 live births in 1990 (Instituto Nacional de Estadísticas y Censos, 1990). The main causes attributed to those deaths were diarrhea and respiratory illness, which represented about 47% of those deaths (El Universo, Dec. 1992). Diarrhea and dehydration

represented about 20.8% of the deaths (Centro de Estudios de Población y Paternidad Responsable, 1990).

Malnutrition and weight loss are often associated with repeated episodes of diarrhea by reducing appetite and by interfering with nutrient absorption and utilization. It is unlikely that children can recover their growth loss without receiving increased amounts of food after diarrheal episodes (US Agency for International Development, 1985-1990). When diarrhea episodes occur, the development or worsening of malnutrition becomes more likely, and the vicious cycle of deteriorating nutritional status and continuing diarrhea become established (Schorling et al., 1990). Mata and co-workers (1977) demonstrated that nutritional status in rural Guatemalan children was more related to diarrheal infections than to the availability of food. Those infections account for most of the energy deficit observed in children from developing countries (Chen and Scrimshaw, 1983). In a study done in rural Bangladesh on the effect of diarrhea caused by enteropathogens on children's growth, it was demonstrated that children, who had a high diarrhea incidence, also had the greatest growth retardation. Growth failure was consistent with cessation of growth during diarrhea or no growth after recovery due to inadequate food intake or additional illness (Black et al., 1981).

Diarrhea is defined in epidemiological studies as the passage of three or more stools in a 24-hour period. A stool is defined as one that could take the shape of a container. It has been determined that there are three kinds of diarrhea, which have different pathogenesis and treatment (World Health Organization, 1992).

The first one is the acute watery diarrhea that lasts less than 14 days but most of the episodes last 7 days. It involves the passage of watery stools without visible food. It causes dehydration when liquids and food intake are reduced, and

vomiting may occur. The most important pathogenic agents involved in this kind of diarrhea are Rotaviruses, enterotoxigenic E. coli, Shigella, Campylobacter jejuni, and Cryptosporidium. In some developing areas, Vibrio cholerae, Salmonella, enteropathogenic E. coli, Giardia lamblia, Entamoeba histolytica, and Ascaris lumbricoides are also important.

The second kind of diarrhea is dysentery where it is possible to see blood in the feces. The main important effects with this kind of diarrhea are anorexia, weight loss, and damage to the intestinal mucosa. The main pathogenic agents involved are Shigella, hemorrhagic E. coli, Campylobacter jejuni, and Entamoeba histolytica.

The last kind of diarrhea is the persistent diarrhea that begins acutely, but it is of long duration of at least 14 days. Episodes may begin as a watery diarrhea or as dysentery. Marked weight loss, marked diarrheal stool volume, and risk of dehydration are frequent. The main pathogenic agents involved are E. coli, Shigella, and Cryptosporidium (World Health Organization, 1992).

There are four mechanisms by which diarrhea occurs: (1) unusual amounts of active osmotic substances in the bowel lumen; (2) increased intestinal secretion of fluid and electrolytes; (3) altered intestinal motility; and (4) intestinal mucosal damage (Donald, 1984). The osmotic mechanism, an imbalance between the bowel contents and extracellular fluid, occurs when poorly absorbed osmotically active substances increase the tonicity of the intestinal contents, causing mobilization of water and some electrolytes from the extracellular compartment to the bowel lumen. It occurs with carbohydrate malabsorption, including lactose malabsorption due to lactase deficiency. The secretory mechanism is caused by impaired absorption of sodium by the villi, while the secretion of chloride in crypt cells continues or is increased. The sodium absorption is mediated by cyclic adenosine monophosphate (cAMP), which is

interrupted by the action of enterotoxins from Rotavirus, E. coli, Vibrio cholerae, and Shigella, altering the cell permeability. The net results are water and electrolyte mobilization into the small bowel, causing a watery diarrhea and dehydration (Donald, 1984). Altered intestinal motility can be a secondary effect of an osmotic diarrhea or inflammation. It occurs when bowel contents have inadequate time of contact with the mucosal villi cells due to a hypermotility, causing a decrease in the intestinal transit time. It leads to an inappropriate intestinal digestion and absorption. On the other hand, hypomotility may promote an increase in the intestinal transit time, leading to bacterial overgrowth, as happens in infectious gastroenteritis or chronic non-specific diarrhea of infancy. Mucosal damage is associated with loss of intestinal surface area, as well as decrease or deficiency of absorptive intestinal enzymes. This affects the absorption of water and electrolytes (Donald, 1984).

There are three types of evidence which show that diarrhea in children has a microbial, parasitological, and viral origin. First, diarrhea is prevalent whenever sanitation and personal hygiene are deficient. Second, older persons are less frequently and are less severely affected than infants and young children, indicating development of immunity. Third, in the community the epidemiology of acute diarrhea is similar to that of other infectious diseases. That is, secondary cases develop after contact with index cases, inducing self-limiting outbreaks or epidemics of varying magnitude. The microbiological examination of acute diarrhea seen in hospitals showed that enterotoxigenic E. coli, Shigella, Salmonella, Rotavirus, Entamoeba histolytica, and Giardia lamblia are the predominant infectious agents in developing countries (Bellanti, 1984).

Enterotoxigenic E. coli (ETEC) is an important etiological agent for acute watery diarrhea among children in developing areas. In a study done in Bangladesh, enterotoxigenic E. coli was found as the most important agent

causing diarrhea among patients of most ages, but it was the second in importance, after rotavirus infections, in two-year old children (Black et al., 1981). It is mostly spread through contaminated water and food. The ETEC does not invade the bowel mucosa; the diarrhea that it causes is mediated by its toxins. The diarrhea generally lasts 3-4 days. The electrolyte content in the stools is about 50-60 mmol per liter for sodium, and 25-35 mmol per liter for potassium. Stools frequently are watery, foul smelling and associated with abdominal pain.

The transmission of rotaviruses is probably person to person either directly or via sewage contamination of water and food. It is one of the most important infectious life-threatening agents in nearly all of the children under 2 years old worldwide. Rotavirus invades the tips of the villi in the epithelial cells of the upper intestinal lumen, causing several defects, such as broadening of the villi and epithelial damage. In severe cases, it causes loss of villi, crypt hypertrophy with extensive damage of the epithelial cells, and marked cellular infiltration in lamina propria. Damage of epithelial cells can affect nutrient absorption; so carbohydrate malabsorption is associated with this virus, resulting in osmotic diarrhea and metabolic acidosis. These unabsorbed carbohydrates are fermented by bacteria, which causes additional symptoms. Rotaviruses cause watery diarrhea, vomiting, and low-grade fever. Stools generally are liquid without blood. Stools also are pale and fatty due to the lack of fat digestion and pigmentation of feces (Cukor and Blacklow, 1984).

Shigella species, such as Shigella dysenteriae and Shigella flexneri, are considered as the most potent agent causing watery and usually bloody diarrhea. Shigella dysenteriae, even though responsible for the most severe symptoms, is found in few cases. Shigella flexneri is the most common species in developing areas. Shigellae produce dysentery by invading the mucosa in the rectosigmoid area. Stools are watery and contain blood. It is accompanied by high fever and

severe abdominal pain. Shigella infection is spread by the fecal-oral route directly and by contaminated fluids and food indirectly (Mitchell and Skelton, 1988).

Salmonella infection is spread by contaminated water and food and also by human carriers. Salmonella outbreaks have been related to water, milk, eggs, poultry, and meat products. In developing countries, salmonellae outbreaks have been more related to water than food (Berkow and Fletcher, 1987). After 48 hours of ingestion, salmonellae invade the enterocytes, mainly in the small intestine. If the small intestine is invaded, as usually happens, the stools are watery and large in volume. If the colon is infected, dysentery occurs (Mitchell, 1988).

After 100 years of absence, the most feared epidemic disease appeared in the Americas in 1992, the cholera epidemic. In Peru, 10,000 patients were treated weekly. By involving other countries, cholera victims were about 391,000 in a year with nearly 4,000 deaths, according to the Pan American Health Organization. In developing countries, especially in Latin American countries, the vibrio was spread by fecal contaminated water distributed by municipal water supplies as well as shellfish and food and beverages sold by street vendors, which have not been cooked or reheated (Glass and Bransling-Bennet, 1992). The Vibrio cholerae is not invasive, and watery diarrhea with electrolyte content is mediated by cholera toxin. Diarrhea can be severe, leading to dehydration, collapse and death if fluid loss and salts are not replaced.

In developing areas, urbanization has created favorable conditions for pathogen transmission, especially parasite transmission. Due to lack of sanitation, Giardia lamblia, Entamoeba histolytica, and Ascaris lumbricoides prevail in urban and suburban areas and it is becoming graver every day (Crompton and Savioli, 1993).

Giardiasis is an infection of the small intestine caused by the protozoa Giardia lamblia, whose action as a pathogenic agent is very well known in developing countries. Giardia lamblia adheres to the epithelial cells of the small intestine, producing local inflammation. In addition, the mechanical action of the Giardia lamblia trophozoites creates a mechanical barrier on the villi, reducing the absorption of nutrients. Trophozoites also cause cell injury and deconjugation of bile acids in the upper small intestine. Most of the patients are asymptomatic and have a brief diarrheal illness. Other patients have watery diarrhea, vomiting, and abdominal cramps (Mitchell and Skelton, 1988).

The association of giardiasis with calorie-protein malnutrition is common. It is thought that malnutrition favors the establishment of Giardia lamblia parasitosis with the formation of a vicious cycle which makes the nutritional status graver. Giardia lamblia is transmitted by contaminated water and by person to person (Fernandez, 1990).

Entamoeba histolytica invades the epithelial cells in the colon or ileum, causing diarrhea, microabscesses, and ulcers. It is spread by contaminated water, food, especially fruits and vegetable, as well as person to person (Fernandez, 1990). Almost 90% of the E. histolytica infections are asymptomatic. In that case, there is not mucosal invasion, even though trophozoites and cysts are present in feces. However, when the E. histolytica strain is virulent, the degree of symptoms goes from mild diarrhea to severe dysentery (Fernandez, 1990).

Ascariasis is an infection due to the round worm Ascaris lumbricoides. It is spread through the fecal contamination of soil and contaminated fruits and vegetables. The infection is more frequent in tropical areas, and it is acquired mainly by children as they may play with soil and put their hands in their mouths. Ascaris lumbricoides takes nutrients from the host, especially carbohydrates; also, there is a disruption in protein digestion due to the inhibition of proteolytic

enzymes, which is in relation to self-defense for this parasite. The graver symptoms include vomiting, abdominal pain, and absence of stool evacuation. In children, the abdomen is swollen due to the great quantity of these parasites. Thin extremities and pale skin are other symptoms present in Ascaris carriers; also, there is delay in growth (Fernandez, 1990).

The mode of transmission of diarrhea-causing agents is rather easy, since it involves a direct or indirect route from anus to mouth. The simplicity of the life cycle of most enteric protozoa, bacteria, and viruses and the large number of infective units excreted in feces explain the high probability of transmission when personal hygiene and environmental sanitation are deficient. Most agents are transmitted from person to person by direct contact through hands contaminated with feces, a common occurrence among children. Limited water availability is a factor favoring this type of transmission in tropical and less developed areas. Animal bacteria and protozoa may induce diarrhea in man. Transmission from animal to human has an epidemiology comparable to that described for person to person transmission (World Health Organization, 1980).

There are some specific behaviors that may increase the incidence of diarrhea:

- Failing to breast-feed exclusively during the first 4-6 months of life,
 - Failing to wash infant feeding bottles,
 - Failing to consume bottles of infant food immediately,
 - Storing cooked foods at room temperature,
 - Drinking water contaminated with fecal pathogenic agents,
 - Failing to wash hands after defecation,
 - Failing to dispose of feces (including infant feces) hygienically
- (World Health Organization, 1992).

Breast feeding is a way to protect children against pathogenic infections by providing immunological protection, antibacterial agents such as lactoferrin, antiviral agents such as immunoglobulins, as well as enzymes and hormones, such as thyroid hormone and prostaglandins (Bullen and Willis, 1971). It was found in a study done in Huascar, Peru, that children had nearly 10 episodes of diarrhea during the first year due to failing breast feeding. It was hypothesized that the infant feeding practices during the first year of life are extremely important as a risk factor for diarrhea. It was found that children under 1 year old fed with teas, milk, and other food instead of breast milk had the highest diarrhea incidence. Children under 6 months, who were fed with milk, food, and breast milk, had a 40% higher incidence of diarrhea than exclusively breast fed infants. Infants of the same age, who were not breast fed, had an incidence of diarrhea 260 % higher than exclusively breast fed infants (Black et al., 1989).

Another study done of the protection against giardiasis by breast feeding among poor Mexican children concluded that breast milk protected against Giardia lamblia infection and symptomatic infections of children by mechanisms that prevent the establishment of the infection. These involve anti-Giardia secretory IgA and potentially not specific factors. Human milk has also been found to protect against Vibrio cholerae toxin, Campylobacter jejuni, and E. coli toxin through specific antibodies found in it (Morrow et al., 1992).

Interventions to promote improved hygiene and better handling, preparation and storage of food can reduce diarrhea morbidity and mortality in developing areas. So, it is necessary to design appropriate interventions by conducting and identifying practices that are risk factors for fecal contamination of food and therefore to be associated with diarrhea incidence (Esrey and Feachen, 1980). Contaminated fingers, utensils, and foods also play an important role in the epidemiology of diarrhea. Contamination of weaning food increases during

the rainy and warm months when conditions within the home favor multiplication of microorganisms in food (Mata et al., 1976).

The Hazard Analysis Critical Control Point (HACCP) process could be done during food preparation at home to determine the hazards and risks that can encourage diarrhea incidence by inadequate cooking processes, food contamination or the multiplication of bacteria in foods which will not be further cooked. The critical points can be identified, preventive methods established and corrective actions implemented (Bryan et al., 1988 a and 1988 b).

The hazards are related to contamination of foods by microorganisms and their survival after the cooking process or post-cooking contamination and multiplication of bacteria during storage. A critical control point in this research is an operation during the process, such as location, practice or procedure, that if not under control could lead to an unacceptable contamination, survival, or growth of undesirable microorganisms. Therefore, it is necessary to plan a monitoring intervention which will check the critical points by watching the procedures or handling processes that are carried out during the home preparation of food (Esrey and Feachen, 1980).

The hazard analysis critical control point system has been applied by Bryan and co-workers in different places, including in food prepared by migrants living in a new settlement in Lima, Peru; in food prepared by inhabitants in the Peruvian Sierra; and in food prepared in Pakistani homes. It was found that boiling temperatures were used during cooking, which were considered enough to kill vegetative forms; however, heat-resistant spores could survive. Leftover food was often held at ambient temperatures for a long period of time, allowing the multiplication of vegetative forms, including those from the surviving spores. Then, leftover food was eaten without reheating or reheated to temperatures considered too low to kill vegetative forms. For these studies, cooking

temperatures, holding times, and reheating temperatures constituted the main critical points that need to be controlled by appropriate interventions, and that are related to pathogenic contamination. Other childhood diarrhea-related critical points to be controlled were proper washing and boiling of the baby's bottles. It was concluded that habits are very difficult to change, but they do change; therefore, it is necessary to train professionals that work in community education, in order to teach adults health information by visiting homes and holding discussions with the families (Bryan et al., 1988-1992).

The introduction of Oral Rehydration Therapy (ORT) is another point considered in the teaching materials. ORT has been very important in the struggle against diarrhea and is an uncomplicated, low-cost and easily obtainable antidote to the dehydration that accompanies diarrhea (Hirschhorn and Greenough III, 1991). The application of ORT has reduced the fatality rate for cholera to about 1% in Chile, Peru, and Ecuador, where contaminated foods, mainly shellfish and beverages sold by vendors, food eaten without reheating, and contaminated water have been incriminated in the spread of the illness (Glass and Bransling-Bennett, 1992).

Oral rehydration solutions help to restore fluid and electrolyte loss through the bowel, and restore children's ability to resume food intake as well. Glucose is not added as a calorie source; but because it enables the coupled absorption of sodium and water. The oral rehydration solution recommended by WHO contains 90 mmol / liter of sodium, 20 mmol / liter of potassium, and 111 mmol / liter of glucose, which is suitable for infantile rehydration with hypovolemia (Finberg et al., 1982).

The management of childhood diarrhea with oral rehydration therapy in the kingdom of Lesotho helped to reduce the admissions to hospitals and deaths in children under 5 years old with diarrhea. More than 97% of children were

treated with oral rehydration solution successfully and discharged to home. This study related the application of oral rehydration therapy to several risk factors associated with hospitalizations in children with diarrhea. Those risk factors were not being breast fed, undernutrition, fever ≥ 38.5 C and dehydration. Breastfed children were less apt to be hospitalized than those who were not breastfed. Undernutrition also was a risk factor for children to be hospitalized. In severe dehydration of children with kwashiorkor, oral rehydration therapy was the choice. Glucose and electrolyte absorption are not affected by nutritional status. Oral rehydration solution must be given in adequate volume to children with moderate or severe diarrhea. It was recommended that oral rehydration therapy information be given to mothers by health educators so that mothers could give the therapy to their children at home. That action could reduce the number of hospitalizations in children with dehydration. Fever ≥ 38.5 C could be due to severe gastroenteritis, other illness, or dehydration. Appropriate oral rehydration treatment must be given to children who present these symptoms (Hatch et al., 1990).

The introduction of solid food during any diarrhea episodes was also considered as part of the program. The treatment of infants with acute diarrhea that is complicated by mild to moderate dehydration includes the introduction of clear liquids for 24-48 hours accompanied by breast milk or diluted formula, which would slowly increase the normal tonicity of the bowel contents, avoiding at the beginning a hyperosmolality in the gut. In older infants and children, solid food such as banana, rice, apple, and toast or tea (BRAT diet) and/or the child's regular diet should be gradually offered as the stools assume a more normal consistency (Bezerra et al., 1992). The introduction of fluids during the first 24-48 hours along with the breast milk, diluted formula and the BRAT diet have been recommended by most pediatricians in the United States according to the American Academy of Pediatrics.

Many theoretical advantages have been proposed for delaying the introduction of food during diarrhea episodes. This theory has been supported by the consequence of nutrient malabsorption. Decreased ratio of crypt cells, alterations in the intestinal transit time, and mucosal damage, which leads to decreased mucosal surface area and decreased concentration of active enzymes are the main causes for carbohydrate malabsorption, especially lactose. Undigested carbohydrate in the small bowel passes into the large bowel where there will be partial hydrolysis and fermentation. Fecal samples of children with diarrhea may show the presence of carbohydrates and a low pH. During acute diarrhea, fat malabsorption may also occur, and bile acids in fecal samples are observed. This also occurs in patients with asymptomatic enteric infections (Brown and MacLean, 1984).

Studies done in Mexican children demonstrated that of 332 patients admitted to a Mexican hospital, 255 were lactose intolerant. Most of them presented with malnutrition of varying degrees, and all of them were dehydrated and had metabolic acidosis and electrolyte deficits. From those patients, 204 infants were given diluted milk formula, and for the rest of them milk formula was substituted. After improvement of diarrhea, children were again given normal concentrations of milk (Lifshitz et al., 1971).

Contrary to the recommendation to delay feeding during diarrhea, there have been many approaches which have favored the introduction of food during diarrheal episodes, based on the need for calories during diarrhea for enterocyte renewal. It has also been stated that enteral nutrition during diarrhea stimulates the absorptive capability of the small bowel by encouraging intestinal enzyme production as a response to feeding. This theory is based on the observation that the decrease of enzyme level is a temporary absorptive response to reduced oral

intake, which rapidly reverses in response to feeding (Brown and MacLean, 1984).

In research done with Peruvian children, the effect of beans in a mixed diet introduced during acute watery diarrhea was studied. For this purpose, two diets were prepared, one made with rice, beans , and vegetable oil and the other one made with rice, soy protein isolate, corn syrup solids, and vegetable oil as a control diet. Beans were considered a protein source and rice was a main staple food in this area. The stool outputs of children receiving the rice-bean diet were greater than the children's stool outputs receiving the control diet. This could be due to the fact that the rice-bean diet had a higher fiber content, suggesting that fiber caused the evacuation of a constant amount of fecal water regardless of the stage of illness. The efficiency of carbohydrate absorption was less with the rice-bean diet, which could be explained because of the higher content of complex carbohydrate in this diet. Fat malabsorption was also observed in children receiving the rice-bean diet; it was speculated that the high content of fiber interfered with the lipolysis process, emulsification process, or the diffusion across the layer of the intestinal mucosa. However, more of the assigned rice-bean diet was consumed than the rice-soy bean isolate diet; and, there was no difference in net energy absorption. It was concluded that the rice-bean diet could be given to children with diarrhea at home, but it is necessary to pay attention to the amounts of ingredients used, which should be similar to those used in this research (Alarcon et al., 1992).

There have been many interventions for the control of diarrheal diseases among children. Some studies have hypothesized that the transmission of enteropathogenic agents, responsible for diarrhea incidence, is increased by specific behaviors, which can be changed through adequate sanitation education. Those that have received most attention are water-handling behavior, food-

handling behavior, and hand washing. A hygienic education program in Guatemala during 1978-1980 was taught to 106 mothers who had children under 6 years. The methodology of this program consisted in using stories and discussions assisted by radio plays and pictures. The content of the program included the recognition and treatment of diarrhea, excreta disposal, hand-washing, breast feeding, food hygiene, care of drinking water, and diet. After the program was taught, incidence of diarrhea was reduced in the children of the target mothers. The diarrhea incidence decreased by 14% among the children aged 0-71 months throughout the year. Moreover, diarrhea incidence decreased by 32-36% among children aged 0-71 months during the peak diarrhea season in the Guatemalan village (Feachen, 1984).

Other educational interventions in rural Thailand were designed to improve hand-washing behavior, mainly before cooking and after eating, and washing dishes immediately after use. It was hypothesized that altered behavior patterns may reduce the incidence of diarrhea. Since any behavior is a model for the whole community, if a positive altered behavior is already being practiced in at least some households, then problems of acceptability could be minimized. The methodology used few and simple messages supported by practices. For example, a plastic container with a spigot was given to each family to reinforce the hygiene message given by demonstrating hand washing and rinsing dishes and the observation of the quantity of water used for these tasks. The analysis for E. coli contamination from hand rinse presented a dramatic reduction, as well as for the stored water (Pinfold, 1990).

In Ecuador, there are some projects which have sought to increase child survival through nutrition education and access to immunization, ORT, and other health services. For example, the Catholic Relief Service works with 70 women's clubs to improve the nutritional status of children under six through promotion of

ORT and immunization, provision of growth monitoring, and other nutrition services. The project HOPE sponsored by the Agency for International Development (AID) seeks the same purpose through nutrition programs, ORT, and other health services. This project involved 3,500 mothers who attended training sessions conducted by health volunteers in 1990 (US Agency for International Development, 1985-1990).

The World Health Organization, the Pan-American Organization for Health, and the UNICEF have distributed handouts directed to the general public, especially to people who do community work. WHO has distributed the Golden Rules to prepare food hygienically. These include advice on choosing foods and treating them safely: to cook food over 70 C; to consume cooked food immediately after preparing; to store cooked food carefully in places over 60 C or under 10 C; to reheat food to over 70 C; to avoid direct contact between raw food and cooked food; to wash hands frequently; to keep all of the kitchen surfaces clean; to keep food away from insects, rodents, and other animals; and to use clean water. All of these points were explained in short messages and main points were highlighted (Organizaciòn Mundial de la Salud- Organizaciòn Panamericana de la Salud, 1991)).

UNICEF has also given a handout, which was directed to community workers. It is an educational guide to sanitation for community water storing systems and environmental sanitation. The purpose of this guide is to look for bonds between water, sanitation, and health. It explains some steps for starting educational programs in sanitation for community workers. For example, how to plan and organize activities for education in sanitation and how to hold discussion with families during visits to their homes. It also describes how to explain the prevention of illnesses related to water, the disposition of feces hygienically, the personal and domestic hygiene necessary in handling food and

water, washing hands, and the benefits of breastfeeding. The handout details each of these points in short paragraphs. Corrective measures are discussed and explained in simple messages supported by figures and graphs (UNICEF, 1990).

In Guayaquil, the Medical School is doing surveys related to diarrhea symptoms and measures taken at home in poor suburban neighborhoods. This community work is conducted by Dr. Luis Serrano, professor of health education in the University of Guayaquil. Students visit homes and do a careful study of the environment around each family, such as materials used to build houses, how families get water, and how families dispose of feces and garbage. In the survey, questions are asked about the number of children who have or have had diarrhea, how many had vomiting during diarrheal episodes, how many children were given liquids, how many children were given food, how many children were given breast milk, and how many children receive or received medicines. The purpose of Dr. Serrano's effort is to increase the student's sensitivity about Ecuadorean social problems (Serrano, 1993).

Community participation has also been encouraged in sanitation projects. The success of this was demonstrated in Belize where community members participated in a sanitation project sponsored by USAID. Discussion included community priorities and problems, different points of view about the problems, and the planning, designing, constructing, operating, and monitoring of the whole sanitation project system. As a result of a three year project, villagers have demonstrated their interest in community problems by asking government for new programs concerning health care, education about nutrition, malaria, dental hygiene, venereal diseases, and related topics (Jenkins-MacLean, 1991).

Table 3. Main diarrhea-causing agents in developing countries (Berkow and Fletcher, 1987)

Condition	Agent	Source of infection
Bacteria	Enterotoxigenic <u>E. coli</u>	Contaminated water and food
	<u>Salmonella</u>	Contaminated water and food (More contaminated water than food in developing countries) Person to person
	<u>Shigella</u>	Fecal-oral route Contaminated fluids and food
	<u>Vibrio cholerae</u>	Contaminated water and food.
Virus	Rotaviruses	Person to person Contaminated water and food
Protozoa	<u>Entamoeba histolytica</u>	Contaminated water and food. Person to person
	<u>Giardia lamblia</u>	Contaminated water
Roundworm	<u>Ascaris lumbricoides</u>	Fecal contamination of soil Contaminated fruits and vegetables

Table 4. Parasite treatments recommended for children and adults
(Quiñonez, 1993)

Infectious agent	Medicine	Dosage in children	Dosage in adults
<u>Giardia lamblia</u>	Metranidazole	250 mg, 3 times/day orally after meals for 5 days	500 mg, 3 times/day
<u>Entamoeba</u>	Metradinazole	250 mg, 3 times/day	500 mg, 3 times/day 750 mg, 3 times/day orally after meals for 5-10 days
<u>A. lumbricoides</u>	Mebendazol	100 mg, 3 times/day orally after meals for 3 days	250 mg, 3 times/day

III. MATERIALS AND METHODS

This was a descriptive study which had four parts:

- 1) Visits to families' homes and observation of food preparation using the HACCP system,
- 2) planning a food and water safety and nutrition program,
- 3) presentation of the planned program to a group, and
- 4) evaluation.

Visits to families' homes and observation of food preparation using the HACCP system.

The purpose of this phase was to watch and document the practices carried out during food preparation. The practices were grouped: arrival of food, storage of food, cooking, time of eating, serving, storing of leftover food, and reheating. During this sequence, temperatures were taken of cooked and stored food; the family's food habits and practices, including the utensils used and ways of storing food, were noted; and the environment of the home, including the family's access to main basic services such as water, electrical power, and fuel were observed. Potential hazards were classified as to degree of hazard.

Food temperatures were measured by introducing a digital thermometer into the geometric center of the food. Freezer and refrigerator temperatures were measured by placing mercury thermometers, range of 10 F (-12 C) to 50 F (10 C), in the freezer and refrigerator for 20 minutes. Temperatures and times were noted for future analysis.

Mothers were asked to do whatever they were accustomed to doing during the day, especially during the cooking process. No special instructions

were given to them before the start of the study. During the less busy parts of the day, mothers were asked the demographic questions. Diagrams of the whole preparation process were drawn in order to note the contamination sources as well as the possible opportunities for food contamination.

Food and water samples were taken during any part of the day. Analysis of these samples for total counts of aerobic microorganisms and molds and yeasts as well as total coliforms and fecal coliforms were done in order to estimate the degree of food contamination as well as fecal contamination, specifically. Parasite analyses were performed on fecal samples from the youngest children in order to study one of the possible causes of diarrhea.

After the HACCP analysis, a meeting with each family was held in order to identify the critical points with them and to present possible controls, paying attention to the economic needs of the family and its food habits. Diagrams were also used to explain to them the future corrective measures. These diagrams were also used in the lessons.

The Hazard Analysis Critical Control Point system was applied in four poor households, located in a south-western area of Guayaquil called "Guasmo Sur-Oeste". In that neighborhood, there is a cooperative, "La Paz", from which all of the families for the HACCP study came. The families were selected by the leader of the cooperative based upon the requirement that the family have infants or young children. Preference was given to families whose children had been known to have had diarrhea recently.

This cooperative was formed by people who had migrated from other provinces. In order to have houses, these families invaded a local swamp that was filled in 1978, the year in which the cooperative was established. Streets were not paved. In 1992, it constituted about 115 families, with an average of 5 members per family. The fertility rate was 3 children per mother. In this

cooperative, most of the women were either not wage-earners or did laundry for other people to make money; most of the men worked as bricklayers in house construction. There were about 250 children under 5 years old, all of whom frequently suffered diarrheal episodes (Norma Nevárez, leader of the community, 1993).

The main materials used for the houses were concrete blocks, bricks, wood, and mat stems for walls and zinc for the roofs. All of the houses had electrical power; none of them had potable water or a sewage system. Therefore, families had to get water from water delivery trucks and had to build latrine systems. Trucks poured water into 100-liter plastic and metal tanks where it was stored. These tanks were located outside of homes in order to be easily reached by the trucks. Also, water from rain during the rainy season was stored in these tanks. Biological wastes were generally collected in pots which were then emptied into plastic bags, and then they were thrown into the latrine. Latrines were located in the patio, off the back part of the house.

There was one social security health center; two schools, one public and one private; one child care center which had an income limitation and was supported by the Instituto Nacional del Niño y la Familia (National Institute of Child and Family). Near by, there was an open market and a bus station.

Of the four families selected for the HACCP study, two were second generation from those who invaded that local land and two had been living in Guayaquil an average of 15 years. The families' economic status and food-preparation facilities influenced the meals that were prepared. Demographic data and descriptive information for each of the four families follows:

Family 1 consisted of four members: mother, father, and two children. The father was 24 years old and was born in another province. He has lived in Guayaquil for 13 years and was a balloon merchant. The mother was 24 years

old and was born in Guayaquil; she was a daughter of a migrant mother. She was a housewife and had finished high school. There were a three and a four year old child. Children ate whatever the adults ate. When they were smaller, diarrheal episodes often occurred. At those times, food based on rice and a lot of liquids were given to them.

This family lived in a four-room house, which they owned. It was made from concrete blocks for walls, concrete for floor, and zinc for roof. It had a patio for washing family clothes and to keep dogs and chickens; however, dogs got into the house often to play with the children. The rooms were: one for living and dining, one for the kitchen, one for the children, and one for the parents. There was a small room as a restroom, which had a bathtub and a toilet which was connected to the latrine by a pipe. Water was gotten from water delivery trucks and stored in two plastic 100 L tanks.

Family 2 consisted of 5 members: father, mother, father's grandmother, and two children. The mother was seven months pregnant. The father was 24 years old and was born in another province. He has lived in Guayaquil for 20 years and was an electrician. The mother was 24 years old and was born in Guayaquil; she also was a daughter of a migrated mother. She was a housewife and had finished high school. Father's grandmother was over 60 years old and because of her rheumatism, the mother had to take care of her. The two children were one and three years old. They often were barefoot due to the hot weather. The youngest one still drank from a milk bottle, but ate some solid food, too; however, this child was not given seafood, peanuts, and avocado because these foods were considered "heavy" for the child. The oldest child sometimes drank from a milk bottle, and he always ate whatever adults ate. In the bottle, children were given banana flour gruel with or without milk, banana-soybean gruel with or

without milk, oat gruel with or without milk, and fruit juices. Diarrheal episodes were often present in the youngest child.

This family lived in a two-room house which was rented; it was made with wood boards for walls, windows, doors, and floor; and zinc for the roof. Behind the house, there was a patio for washing family clothes and keeping many ducks and chickens. A dog and five cats were kept in the house to play with the children. The rooms were: one room for the children's beds and the dining and the other one for the adults' beds and the kitchen. They did not have a room for a restroom; their biological wastes were thrown into the latrine directly by using plastic bags. Water was gotten from water delivery trucks and stored in two 100 L metal tanks.

Family 3 consisted of seven members: father, mother, and five children. The father was 35 years old and was born in Guayaquil. He was a car mechanic. The mother was 33 years old and did not work outside of the home. She was not born in Guayaquil, but had been living in Guayaquil for 18 years. She finished half of the high school; however, she studied one year more to become a hairdresser. There were five children, ages four, seven, eight, nine, and twelve years. All of them ate whatever the adults ate.

They lived in a three-room house which they owned. It was made from concrete blocks for walls, wood boards for windows and doors, concrete for floor, and zinc for the roof. This family did not keep any animal on the patio which was used for washing clothes. A cat was kept inside the house. The rooms were distributed as: one room for the living and dining, one room for the kitchen, and the third for the adults' and children's beds. They did not have a room for the restroom, and biological wastes were directly thrown into the latrine. Water was gotten from water delivery trucks and stored in two plastic and metal 100 L tanks.

Family 4 consisted of five members: father, mother, and three children. The father was 32 years old and was born in Guayaquil. He was a watchman. The mother was 30 years old and was born in another province, where she had lived until she was 15 years old. She finished elementary school. She was not a wage earner. There were three children: the oldest was nine years old, one was 4 years old, and the youngest was six months. The older children ate whatever the adults ate. The youngest one still drank from a bottle but also ate some solid food.

This family lived in a two-room house made from mat stems for walls, wood boards for windows and doors, sand for floor, and zinc for the roof. The land where the house was built belonged to the mother's parents. They did not pay rent, but they could not extend the house. The house did not have a patio, and family clothes were washed in front of the house. A cat was kept in the house. The rooms were distributed as: one for dining and living and the other one for the children's and adults' beds. Their biological wastes were thrown into the latrine. Water was gotten from water delivery trucks, and stored in a 100 L metal tank.

The HACCP control family was constituted of a mother and two boys, 1 and 5 years old. The mother was 25 years old and single. She was born in another province and had been living in Guayaquil for 10 years. She did not finish elementary school and worked doing laundry for other people. They lived in a two room house made from bush and tree stems for walls, wood for doors and windows, and zinc for the roof. The rooms were distributed as: one for dining and kitchen and one for beds. The house had a patio where many ducks and chickens were kept. They also had a dog and a cat, which often were in the house. They had a latrine where biological wastes were discarded. Water had to be gotten from water delivery trucks; it was stored in a 100 L metal tank. The children always were barefoot. They generally attended the child care center of the cooperative, where they stayed until early in the afternoon. Both of them ate

whatever their mother ate, but the youngest still drank from a bottle in which he was given oat gruel without milk and fruit juices.

From these families, water and food samples were taken for total count of aerobic microorganisms, molds and yeasts, total coliforms, and fecal coliforms. Samples were taken in sterilized bottles. A tablespoon, sterilized with 95% alcohol and flamed, was used to take food samples. The analyses were done in the Departamento de Microbiologia Sanitaria of the Instituto Nacional de Higiene y Medicina Tropical "Leopoldo Izquieta Perez". Water methods were based on the 16 th. edition of the Standard Methods for the Examination of Water and Wastewater. The findings were interpreted by the analysts based on the standards of the Instituto Ecuatoriano de Normalizacion (INEN). According to INEN, water fit for human consumption must have an absence of total aerobics as an optimum limit and 30 colonies per cc as a maximum limit and the absence of total coliforms as both an optimum limit and a maximum limit.

The pour plate method was used for total counts of aerobic microorganisms, molds, and yeasts. The medium used was Plate Count Agar (tryptone, glucose, yeast extract); incubation was at $36\text{ C} \pm 1\text{ C}$ for 48 hours for aerobic microorganisms and at $21\text{ C} \pm 1\text{ C}$ for 3-5 days for molds and yeasts. The Most Probable Number (MPN) was the method used for total coliforms and fecal coliforms. The medium used for total coliforms was brilliant green lactose bile broth. Incubation was at 35 C for 48 hours. The medium used for fecal coliforms was E.C. medium; incubation was at 44.5 C for 24 hours. Gas formation was considered positive for total coliforms and fecal coliforms. In some cases, the membrane filter method was used to analyze for both total coliforms and fecal coliforms. The medium used was R2A agar at 35 C for 48 hours.

Fecal samples from the youngest children were taken for parasitological analysis. Mothers were instructed on how to get the fecal sample using flat wood

sticks, and they were given sterilized little plastic boxes for sample collection. The fecal samples were from the children's first stools and were obtained very early in the morning. Fecal samples were taken to the clinical analytical lab where analyses were performed under the direction of Dr. Gloria Bajaña de Pacheco, head of the food technological program of the Escuela Superior Politecnica del Litoral in Guayaquil. Each fecal sample was examined by mixing a drop of fecal material with saline solution. On a microscopic slide, the fecal material was homogenized and covered with a cover slip in order to observe it under a microscope. Fecal samples from children with diarrhea were not diluted. Sometimes, parasite structures could not be observed; a preparation was then made with lugol with which the fecal material was homogenized and diluted. In both cases, samples were examined within a maximum time of 10 minutes after dilution. A minimum of four slides of each stool sample were examined in order to identify as great a number of parasites as possible.

Planning a food and water safety and nutrition program for mothers.

This part was based on the Hazard Analysis Critical Control Point observations during visits to families' homes which will be presented in the Results and Discussion section. The main purpose was to plan a program which could be adjusted to the economic needs of the family and its food habits. The program consisted of four lessons: food and water safety, the parasites, care during diarrheal episodes, and nutrition. The outline and graphics for each lesson are in the appendix. The lessons were written on big papers measuring 41" x 28". After it was learned that all of the mothers knew how to write and read, handouts were prepared, which contained the major concepts.

The food and water safety lesson and graphics were based on the HACCP observations and the food safety visual teaching series published by the Agricultural Extension Service of the North Carolina State University (1981). The food and water safety lesson emphasized how to prepare and store food more safely; when it is necessary to wash your hands; and how to wash food utensils, depending on whether you are preparing raw or cooked food. Other clues to healthy living were included such as: not eating outside of the home, keeping pets clean and away from the kitchen, having children wear clothes and shoes as often as possible.

The parasite lesson was mainly based on the findings from the children's parasite analyses as well as the World Health Organization series published in 1980. Dr. Gina Quiñonez, Gastroenterologist for the Police Medical Care Center of the province of Guayas and the Social Security Hospital, advised the author concerning the main causes of parasites in children as well as the parasite treatment to be recommended. The parasite cycle was based on the text de Medicina Tropical written by Dr. Telmo Fernandez, professor at the medical school in Guayaquil (1990). Main points in the parasite lesson included: what parasites are and the main parasites found in children, according to the parasitological analyses from children; how they could be transmitted to humans and medicines recommended for those parasites.

The third lesson, the care in diarrheal episodes, was mainly based on what had been learned about the families' habits during diarrheal episodes in their children, as well as the prevention of diarrhea and care that was edited in Quito by the Women and Health organization (Camacho and Llorè, 1989). It was also based on the community worker's manual (Caribbean Food and Nutrition Institute, 1986) as well as the effect of inclusion of beans in mixed diet for the treatment of Peruvian children with acute diarrhea (Alarcon et al., 1992) and the banana, rice,

apple, tea or/and toast (BRAT) diet recommended by the Pediatrician Association (Bezerra et al., 1992). The lesson on the care during diarrheal episodes included: types of diarrhea, the meaning of dehydration; and oral rehydration therapy. Introduction of solid food after each diarrheal episode, based on the families' habits and the use of the banana, rice, apple, tea or toast (BRAT) diet, was also covered.

The last part of the program, the nutrition lesson, was mainly based on a publication edited by the Extension Service of U. S. Department of Agriculture (1977) as well as on the families' food habits. The author could not locate any food guides developed for Ecuador. The nutrition lesson included the use of essential nutrients in the body and the four groups of foods with daily recommended servings.

Presentation of the planned program to a group of mothers.

In order to teach the planned program, a local child care center was contacted. Mothers whose children had had diarrhea lately were identified. Their cooperation and schedules were requested in order to choose the best time for the class. The class schedules, the date of the first class, and the topics of the class were posted at the child care center.

The classes were held each Saturday for one month. Each class lasted approximately three and one-half hours and was held at the child care center. Lessons and graphics were read and explained. Handouts, containing the main points, were given to each mother in order for them to follow the program. These handouts were given during the second class, when it was learned that they were literate. Mothers were led to participate in the program by asking them if they had

questions. Refreshments were served one and half hours after the beginning of class.

The mothers to whom the program was taught had the following characteristics: Mother 1 was 26 years old and an elementary school teacher. She was born in Guayaquil; her parents had migrated to Guayaquil 30 years ago. She was married to a doctor and had a three year old boy and a one year old girl. She lived in a middle-class neighborhood, close to the child care center, where potable water was available twice a day; in addition, she stored water in a 500 L tank to be used during the day. Both of the children ate whatever the adults ate; but the girl also drank from a milk bottle in which she was given fruit juices, powdered milk, and a gruel made from milk, apple, and plantain flour.

Mother 2 was 33 years old and had finished elementary school. She worked as a maid in a middle-class family who lived close to the child care center. She was born in another province and has lived in Guayaquil for 18 years. She was single and had a three year old daughter. They lived in a poor urban neighborhood where water was obtained from water delivery trucks and stored in a 100 L tank made from metal, which was located outside of the house. Her little girl ate whatever her mother ate, and she still drank from a milk bottle in which she was given powdered milk, oat gruel with apple, and fruit juices.

Mother 3 was 29 years old and was born in Guayaquil. Her parents had come from another province and had been living in Guayaquil for 35 years. She was married to a commercial engineer, as well as being one herself. They had two girls, five and two years old. Neither of the children drank from a bottle; both ate whatever the adults ate. They lived in a middle-class neighborhood, not close to the child care center. Their house did not have potable water; therefore, water from water delivery trucks, was stored in a 8000 L concrete cistern and pumped to the house.

Mother 4 was 22 years old. She was born in another province and had been living in Guayaquil for three years. She finished elementary school. She was single and worked as a maid in a middle class family where she lived with her three year old daughter. Her child ate whatever mother ate. The house, where they lived, was located close to the child care center and got water from a water pipe twice a day. In addition, water was stored in a 8000 L concrete cistern and pumped to the house.

Mother 5 was 23 years old. She was born in another province and had lived in Guayaquil for four years. She finished elementary school. She was single and worked as a maid in a middle-class family; however, she and her two-year old girl did not live with them. They lived in a southern poor urban neighborhood, where she got water from water delivery trucks and stored it in a metal 100 L tank. The child drank from a bottle in which fruit juices, oat gruel, and reconstituted milk were given. The child also ate whatever the mother ate.

The mother selected as the control for the program was 22 years old and a university student. She was born in Guayaquil, but her parents came from another province 30 years ago. She was married to a lawyer and had a two year old boy. They lived in a middle-class neighborhood close to the child care center, where they had to get water from the water pipe twice a day; in addition, water had to be stored in two-100 L plastic tanks. The boy ate whatever the adults ate, but he also drank from a bottle in which he was given a banana with milk mixture, fruit juices, oat gruel with milk, and apple gruel with milk.

During the first class, three mothers came and were personally interviewed in order to learn the demographic data, their knowledge of water and food safety, the incidence of diarrhea in their children, and the measures taken during diarrhea episodes. The questions were chosen based on responses to pilot interviews of urban families. The first time, a yes-no format was chosen, but those questions

were not understood. In addition, simple questions with clues to the answers were answered by the mothers who responded with what they believed to be the expected answers. The question format is summarized in the Appendix. Part of the food and water safety lesson was also given during the first class.

During the second class, five mothers came; therefore, time was spent in interviewing these additional mothers and viewing the program given in the first class. During the second class, the food and water safety lesson was completed and the parasite lesson was presented. Handouts were given in this class because it was learned that the mothers knew how to read and write.

The third class was the care during diarrheal episodes lesson. The last meeting was the nutrition lesson. During this class, recommendations were made. Each mother was personally interviewed with questions based on the program .

The three mothers, who came the first day of class, were asked to bring fecal samples from their children for parasite analysis. Fecal samples were brought the following Monday, very early in the morning, and taken to the laboratory.

Evaluation

This phase had two parts: The first was conducted at the end of the fourth class. It was an oral interview of the mothers. This survey had four parts of questions covering food and water safety, parasite control, care during diarrheal episodes, and nutrition. The purpose was to assess the knowledge they had learned from the program and to learn if any part of the program was confusing to them. They were also asked if there were problems that could prevent the

application of what they had learned. The interviews were sound-taped for later analysis.

The second part included visits to families of both the groups who had participated in the HACCP studies in their homes and the families of the women in the program. The visits were one month after the last meeting with the urban families in the HACCP study and three weeks after the last meeting with the group of mothers coming from the child care center. During the visit, an informal atmosphere of friendship was developed. The visits were during any part of the day to include cooking or meal time. The applications of the food and water safety concepts were discussed with the families and documented.

Both groups were asked if their children had had diarrhea in the past month, if they had been hospitalized, and what the doctor had told them about the causes of diarrhea. Fecal samples were again taken from the youngest children coming from the HACCP families. Problems that might prevent their continuing the application of the program in the future were determined.

The HACCP study was done in the control family; food temperatures and food history were documented, but there was no discussion with the family about the critical points. The control mother for the program was also visited. Limited comparisons were made with the families who had received information about the measures to be taken for the critical points and the group of mothers in the program.

IV. RESULTS AND DISCUSSION

Visits to families' homes and observations of food preparation to develop the HACCP system

Flow diagrams of the HACCP observations for each food prepared that day and for boiled water are presented in Figures 1-6. Temperatures and times recorded during the cooking processes are shown in Table 5. Results are also based on the microbiological analysis of food and water samples, as well as parasite analyses from young children. Microbiological findings for total aerobic microorganisms, molds and yeasts, total coliforms, and fecal coliforms are shown in Table 6. Microbiological data for water samples are shown in Table 7. Parasite analyses of young children are presented in table 8.

Observations. In the arrival of food phase, it was observed that all of the families bought food daily. Food was usually purchased between 9:00 and 10:00 a.m. from the open market and small stores located around their houses. At these markets, fruits and vegetables were generally placed in wood boxes on the floor, on wood tables, or on a small piece of jute fabric on the floor. Because of the rainy season, water accumulated on the open market floor and streets, and many flies and mosquitoes were around.

Generally, food was sold in smaller quantities than it was packed because it was more economical for families to buy food in this way. Therefore, food such as thin noodles, cheese, cinnamon, cumin, and sugar were taken from their sealed packages and wrapped in paper. Some of the foods, such as rice, some vegetables, some fruits, and beans, were sold in plastic bags. All of the families used a plastic basket to buy vegetables, such as plantains, potatoes, carrots, cabbage, and lettuce, and some fruits, such as bananas. Beef was hung from

metal hooks, and seafood was placed on wood tables at the open market. Neither was refrigerated. Both products were wrapped with newspaper after being purchased.

In the storage of food phase, it was observed that two of the families did not have refrigerators. Food was held at an ambient temperature of about 86 F (30 C) for approximately 2-3 hours between purchase and preparation. Very perishable foods, such as meat and milk, were consumed the same day as they were purchased. Foods, such as plantains, potatoes, onions, tomatoes, green peppers, and some fruits, were stored in a plastic basket on the floor under the kitchen sink. The other two families stored foods in the refrigerator as soon as they returned from shopping. They stored very perishable foods such as meat and seafood in the refrigerator freezer at temperatures of 14 F (-10C) - 10 F (-12 C.). Foods such as milk, fruit, and vegetables, were stored in the refrigerator at temperatures between 43 F - 50 F (6 C - 10C).

One of the families stored raw water in plastic containers with lids, which were in the refrigerator to drink during the day or used to prepare fruit juices and powdered milk. Three of the families boiled water in aluminum pans with lids. The water was stored in the same pans by two families; the other one stored boiled water in plastic containers in the refrigerator. This boiled water was used for drinking during the day and to prepare fruit juices and powdered milk.

In the cooking process phase, most of the mothers did not have the habit of washing their hands before starting to prepare food; only one of the four mothers washed her hands before beginning this process. Food utensils used during the cooking process and the ingredients used to prepare the meals, such as meat, vegetables, and fruits, were washed with raw water. In some cases, vegetables were washed after peeling but this process was not always carried out. One family used detergent to wash vegetables and fruits. Detergent was

generally used to wash the cooking utensils. In order to save water, all of the families used small plastic bowls which were placed in the metal kitchen sinks. Food and food utensils were washed in these plastic bowls. After washing, if the water was seen as very dirty, it was discarded in the sink; but otherwise, it was recycled by using again to wash fruits and vegetables especially.

A gas stove was used by all of the families. Family 1 prepared a canned tuna soup with noodles and potatoes (Fig. 1), as well as tuna salad with mayonnaise (Fig. 2), which was accompanied by steamed rice and lemonade. The canned tuna soup reached boiling temperature and was cooked at 210 F (99 C) for approximately 45 minutes (table 5). The potatoes for the tuna salad also reached boiling temperature; they were cooked at 212 F (100 C) for 35 minutes. The lemonade was made with raw cooled water.

Family 2 prepared a soup with beans, potatoes, carrots, cabbage, cheese, and pasteurized milk (Fig. 3). Cheese was removed from the sealed package and a smaller piece cut off. It was washed with raw water and chopped by hand. The soup was cooked at 208 F (98 C) for 50 minutes (Table 5). This family also prepared an oat gruel with milk for the children as a midmorning refreshment (Fig. 4). This refreshment was cooked at 204 F (96 C) for 20 minutes (Table 5). After cooking, it was drained while very hot and mixed with sugar later.

Family 3 prepared a meat stew with lentils, potatoes, and cabbage (Fig. 5), which was accompanied by plain steamed rice. The meat stew was cooked at 210 F (99 C) for 40 minutes and the steamed rice was cooked at 212 F (100C) for 35 minutes (Table 5).

Family 4 prepared a meat stew with potatoes (Fig. 6) which was accompanied by a rice with bean dish. The meat stew was cooked at 218 F (98 C) for 50 minutes. The rice and bean mixture was cooked at 210 F (99 C) for 45 minutes (Table 5).

All of the families used garlic, onion, white onion, tomatoes, celery, and green pepper as seasoning and flavoring along with salt. Achiote was often used to color the meals. It is a natural colorant which was liposoluble at high temperatures; families always had achiote and oil together in a small pan, a few drops of oily achiote were enough for coloring food, the rest of it was held at ambient temperature until used again.

As breakfast, families usually ate fried pieces of plantain or bread, and coffee. Younger children usually drank oat gruel with apple or soybean-banana gruel or banana gruel with or without milk. However, children from family 1 usually drank hot chocolate with milk or oat gruel with milk or a glass of milk. None of the families, neither adults nor children, met the daily requirements for milk.

As a dinner or supper, family 2 and family 4 ate whatever they had left at the lunch time. Family 1 and family 3 generally prepared a new meal to eat together with father. Family 1 prepared a shrimp stew with blended green plantain (sango) with steamed white rice. Family 2 prepared a dish with fried meat, tomatoes and onions. All of the families used at least one tablespoon of soybean oil in all of the meals, including the steamed rice, either for frying or with the achiote coloring.

Three of the families boiled water, a 30-minute process, to drink during the day or to prepare fruit juices and powdered milk. Milk was usually reconstituted from powdered milk by using boiled water. One did not boil water to drink or to use to prepare fruit juices and powdered milk. This family thought that it was enough to cool water in a refrigerator in order to kill microorganisms.

The serving and eating phases were also observed. Families did not have the habit of washing their hands before starting to eat; only two of the four families washed their hands before eating. Lunch was usually served from 12:00-12:30.

Generally, pets were around the table during the eating period. Hot foods were generally served about 176 F (86 C) (Table 5), except the oat gruel, which was held at ambient temperature for 120 minutes until it cooled. It was given in bottles to the children. All of the families washed dining ware and silverware with raw water and detergent.

During the food storage and reheating phases, it was observed that all of the families held leftover foods at an ambient temperature of about 81 F - 86 F (27 C - 30 C). The time of holding leftover food differed. Mothers in two of the families held leftover foods for 3-4 hours after the meal was cooked. The leftover food was not reheated before eating and was eaten by children whenever they felt hungry. The other two families held food for 5-6 hours because they waited for fathers to come home so they could eat together. Foods were reheated to warm temperatures of 104 F - 122 F (40 C - 50 C) for 3-4 minutes. One of these families did not give the youngest child (one year old) bean soup prepared with milk; however, the child was given potatoes and beans which were picked from the soup.

Laboratory analyses. Perishable foods were sampled at different intervals of time for total aerobic counts, molds and yeasts, total coliforms, and fecal coliforms. Data are presented in Table 6. From family 1 a sample was taken of the tuna soup after one hour at ambient temperature. It had a total aerobic plate count of 18,000 colonies per gram of sample. None of these were types that indicate fecal contamination. From family 2 a sample of an oat gruel sample held at ambient temperature for 120 minutes after cooking was taken. At that time, the children drank from the bottle for the second time. The gruel sample had a total aerobic plate count of 30,000 colonies per gram of sample, and a count of 800 colonies of molds and yeasts per gram of sample. No bacteria were identified which were indicators of fecal contamination. From family 3 the sample was a

meat stew with lentils, cabbage, and potatoes which had been held at ambient temperature for 3 hours after it was cooked. At that time, the leftover food was eaten without reheating. This sample had 30,000 colonies of aerobic bacteria per gram of sample, and 50 colonies of molds and yeasts per gram of sample. No coliform bacteria which would be indicators of fecal contamination were found. From family 4, a meat stew sample with potatoes was taken 15 minutes after cooking at 194 F (90 C). It had no colonies of aerobic bacteria, molds, or yeasts.

Water samples were analyzed for total counts of aerobics, total coliforms, and fecal coliforms. None of the analysed water samples was safe for human consumption as determined by the Ecuadorean National Institute of Standards. Even samples which had been boiled were found to be contaminated. A water sample from the cooled water, which was usually drunk and had been used by the family, was taken from family 1. This sample had 3,000 colonies of aerobic bacteria per mL of sample, 150 colonies of total coliforms per 100 mL of sample, and 50 colonies of fecal coliforms per 100 mL of sample (Table 7). Because of the high number of aerobics and the presence of germs that indicated fecal contamination, it was suggested that corrective measures be applied immediately because this water was not fit for human consumption.

A sample of boiled water held at ambient temperature was taken in family 2 after glasses were also filled to be drunk by children. The sample had 3,000 colonies of aerobics per mL of sample, 16 colonies of total coliforms per 100 mL, and 8.8 colonies of fecal coliforms per 100 mL. The presence of these indicated probable fecal contamination. This water was not fit for human consumption. It was also suggested to apply corrective measures immediately.

From family 3, a boiled-cooled and stored water sample, which had had water taken from it, was taken, which had 60,000 colonies of aerobics per mL of sample, no colonies of total coliforms, and no colonies of fecal coliforms. Another

sample of boiled water which had been refrigerated was taken the following day. One of them was boiled for 10 minutes and was not used prior to sampling. It had 6,000 colonies of aerobics per 100 mL of sample, no colonies of total coliforms, and no colonies of fecal coliforms. The other water sample was boiled 15 minutes and was not used before sampling either. It had 4,800 colonies of aerobics per 100 mL of sample, no colonies of total coliforms, and no colonies of fecal coliforms (Table 7). These water samples also did not meet the Instituto Nacional Ecuatoriano de Normalización standards for potable water; it was suggested that corrective measures be applied.

From family 4 a sample of boiled water which had been held at ambient temperature was taken. It had 3,000 colonies of aerobics per mL of sample, 14 colonies of total coliforms per 100 mL, and 5 colonies of fecal coliforms per 100 mL (Table 7). This water also did not meet the standards for potable water. It was also suggested that corrective measures be applied immediately.

Parasite analyses of the young children's feces showed the abundant presence of Entamoeba histolytica, Entamoeba coli, Ascaris lumbricoides, and cysts of Giardia lamblia, Heminolepis nana and Chilomastix mesnilli were also present (Table 4).

Critical control points. The critical points in the flow diagrams shown in Figures 1- 3 and 5 were contamination sources in the food preparation process, temperatures used in the cooking and reheating steps, time and temperature used during leftover food holding and reheating steps, and washing of utensils used in the serving step. Since all of the cooked foods reached boiling temperatures, only heat resistant spores could survive in this process. Time is a critical control point considered as a hazard if food is being held at a temperature which permits bacterial multiplication. In the leftover food holding step, time is one of the conditions for spore germination and bacterial multiplication. In the leftover

reheating step, time was one of the conditions to kill bacteria. Families usually thought that when food was boiled, it was ready to eat and turned off the gas stove but left food there. Washing of utensils was considered another critical control point in the serving step, since contamination from hands, pets, rodents or insects could occur; raw water was considered one of the main hazards in the process, detergent could help remove contamination.

In Bryan's studies done in Peru (Bryan et al. , 1988 a and 1988 b), the critical control points determined were temperature for the cooking step, time for the leftover food holding step, and temperature for the reheating step. Water was not a major concern in these studies, so it was not analyzed. In this study, it was shown to be a major hazard. Since raw water had high numbers of fecal coliform colonies, the proper washing of utensils was also considered as a critical control point in the serving step in this study. Boiled water (Fig. 7) had as critical control points time for the boiling step and holding step and proper washing of containers for both pouring into other containers and serving steps.

Additional critical control points were considered in the oat gruel preparation (Fig. 3): proper washing of hands and proper washing and boiling of bottles. Boiling bottles was advised after bottles were washed. That generally was done by the families with young children. Writers of a recent manual for managers of health programs (Jelliffe and Jelliffe, 1991) recommended that a cup and a spoon, not a feeding bottle, be used for infants and children.

Control measures were identified. These were the basis for the development of the educational lessons. They were also presented to the participants in the HACCP study. Control recommendations were made on improving practices during storage, cooking, holding of leftover food and reheating phases.

In the storage phase, it was recommended that food be stored in containers with lids. The plastic basket should be on a high place to avoid insect or pet contamination.

During the cooking phase, hand washing was recommended after defecation and urination, playing with pets, blowing the nose, changing child's diapers, and starting to prepare food that would be eaten raw, such as vegetable and fruit salads, juices, and ceviches. It was also recommended that only food utensils to be used to prepare food that will be cooked be washed in raw water. All of the food utensils used during the cooking process should be washed with detergent. Food utensils should be rinsed with boiled water if to be used to prepare foods eaten raw, such as vegetable salads, fruit salads, fruit and vegetable juices, and ceviches. Fruits and vegetables used raw, such as in raw salads, should be washed in raw water but rinsed with boiled water at the end of the process. It was also advised to use detergent to wash the surfaces where food is placed. Mothers were also advised not to handle food if they have a cut finger or infection; if there are little cuts, use an adhesive bandage.

Because cholera currently was present in Ecuador, it was advised to cook seafood well, including when ceviches are being made, and not to eat outside the home. In the home, it is possible to be sure that all drinking water is boiled, the vegetables for salads as well as fruits are washed and rinsed with boiled water, and all foods are well cooked and fresh. Children can avoid eating outside the home by taking home prepared refreshments to school.

For storage and reheating, it was recommended that leftover food be stored in the refrigerator. If none were available and food will be held a long time (more than 3 hours), leftover food should be reheated thoroughly every two hours to avoid food spoilage. It was also advised to reheat leftover food as if cooking again for at least 5 minutes, mixing several times.

During the boiling water process, time of boiling, time of holding water until it cooled, and proper washing of utensils used for removing water as needed were considered as the main hazard areas in this process (Fig. 7). It was recommended that water be boiled at least 30 minutes and that unboiled water should not be drunk. Utensils used for storage should be rinsed with boiled water before using. The utensils used to boil water should be kept only for this purpose. Glasses should also be rinsed with boiled water before being put upside down on a tray to avoid fly and other insect contamination.

Other advice was to keep pets out of the kitchen and away from the dining table, to give them a bath at least three times a week, and to give them antiparasite medicines at least twice a year. Children should not be allowed to kiss the pets on their mouths or tails.

Based on the parasite findings from the young children, families were also warned that parasites could be transmitted in many ways: from person to person because of his/her contaminated hands, from animal to person due to one not wearing shoes, drinking raw water, eating contaminated raw foods. Children and the whole family should be checked for parasites at least twice a year because parasites do not allow food to be used for energy to work, read, study, play, dance, etc. They also cause internal hemorrhage and anemia. Over the long term, they are a risk for malnutrition, especially of children because they are more susceptible to parasitic illness.

If parasites are found, it is necessary to follow an antiparasite treatment according to the kind of parasite. Medication must take into account the age of the individual. It is necessary that the whole family start the treatment together, because what one member of the family has, the whole family probably has. Although the value of treatment has been questioned, given the probability of reinfection, research in Africa has demonstrated the value of treating children.

Care during diarrheal episodes. The preparation of oral rehydration solution at home was advised. It was explained that these solutions help your child feel better by recovering fluids and salts lost during diarrheal episodes and recovering the child's appetite. The oral rehydration solution is easy to prepare and can save the child's life until a doctor or pharmacy can be reached. Oral rehydration solution preparation is: in one liter of boiled water, add 8 teaspoons of sugar and 1 teaspoon of salt. The quantity of oral rehydration beverage that should be given the child will depend on the child's age and weight. For a child under 1 year and weight 2-7Kg, he/she should be given 1-2 glasses (8 Oz, 237 mL) in 2 hours. For a child whose age is 1-5 years old and weight 7-15 kg, he/she should be given 3-5 glasses in 2 hours. For a child over 5 years old, he/she should be given 6-10 glasses in 2 hours. The solution should be given in small amounts frequently (every 15 minutes).

It was recommended to continue to give breast milk if children will eat or dilute milk formula or powdered milk until the child is better. Older children can be given banana, rice, apple, toast or bread, and tea or herbal water. If the child continues with persistent diarrhea, it may be necessary to stop giving milk. One should continue to give the child a beverage and concentrated gruels made from rice, oats, or any other grain, such as quinoa or lentils. One can make a soup with potatoes, rice and vegetables, such as carrots and green beans without oil. The child should not be given fried or greasy food. Chicken broth made from chicken without skin can be served. For professionals, more specific recommendations are available from WHO (Jelliffe and Jelliffe, 1991).

Nutrition Program. General nutrition advice was included in the informal lessons. Families were taught about the four food groups and amounts recommended from each group. Foods commonly eaten in Ecuador were used as examples. From the milk group, there is any kind of milk such as powdered,

condensed, and evaporated as well as alternatives such as cheese, yogurt, and ice cream. The meat group includes any kind of meat such as chicken, beef, and seafood, beans and eggs. The fruit and vegetable group included juice made from any kind of fruit, bananas, chopped fruit, grapefruits, oranges, etc. The bread and cereal group includes any kind of food that has a lot of starch such as bread, cereal, pasta, plantain, cassava, crackers.

After talking to families about what they should do, families were asked if there were any problems in applying the corrective measures. Answers from the 4 families were no; however, two of the families could not buy the antiparasite medicine because it was very expensive; and therefore, they could not follow the advised antiparasite treatment. The third could afford only to give this treatment to children because they had 5 children. Only one of the families could follow the complete recommended treatment. Families were told that if it was not possible to follow the antiparasite treatment, they should apply the corrective measures for food and water care in order not to make the situation more grave.

The HACCP control family purchased food from the open market and some from small stores close to their home. Generally, food was bought daily. Very perishable food was gotten the same day as it was eaten. Some foods, such as potatoes and plantains, were stored in a plastic basket. Water was boiled to be consumed just by the children; and, it was also used to prepare fruit juices and powdered milk. The mother drank raw water. Rice with lentils was cooked at 208 F (98 C) for 50 minutes. It was served very hot at 176 F (80 C). All of the raw ingredients as well as the food utensils were washed with raw water coming from water delivery trucks. Leftover food was held on the gas stove for a long period of time; it was not reheated.

Presentation of the planned program to a group of mothers.

Pretest. Pretest data on mothers' answers to oral survey questions are given in the Appendix . Mother 1 had a good knowledge of water and food safety. Food was stored in the refrigerator and meat, chicken, and seafood were stored in the freezer. Water was boiled to drink during the day as well as to prepare powdered milk and fruit juices for the whole family. When her youngest child was less than 1 year old, she used to have diarrheal episodes often; the doctor told her that diarrhea was due to parasites because her child started putting her hands into her mouth. The child recently had had diarrhea. A lot of liquids and Pedialyte was given to the child during diarrhea. During recovery, rice water, a soup with noodles and milk, and a chicken broth were given.

Mother 2 also had a good level of knowledge about water and food safety. Water was boiled in an aluminum 5 L lidded pan; it was used to drink during the day as well as to reconstitute powdered milk and to prepare juices. Food was bought daily and stored in plastic containers with lids. Very perishable foods such as meat were stored in her sister's refrigerator. Her daughter had often suffered with diarrheal episodes since she was one year old; she was almost hospitalized once. During diarrhea, she was given a lot of liquids, lemonades, and rice water with apple. During recovery, she was given a soup with milk, cheese and noodles, and a soup with milk, rice and cheese.

Mother 3 also was knowledgeable about food and water safety concepts. She stored food in the refrigerator; very perishable foods such as beef, chicken, and seafood, were stored in the freezer. She always boiled water to drink during the day as well as to reconstitute powdered milk and to prepare juices. However, her youngest child had often had diarrheal episodes. Pedialyte, a lot of liquids,

apple juices, mashed apple, and apple sauce were given during diarrheal episodes. During recovery, the child was given chicken broth and a soup with chicken, potatoes, and other vegetables.

Mother 4 had little knowledge about food and water safety. In the house where she and her daughter lived, food was stored in the refrigerator; water was boiled to drink during the day as well as to prepare the child's reconstituted milk and fruit juices. When her child was younger, she often had diarrheal episodes; however, she had not had any lately. During diarrhea, the child was given a lot of liquids, lemonades and oat gruel. During recovery, she was given a soup with milk, potatoes, and noodles.

Mother 5 also had little knowledge about food and water safety concepts. Food was bought daily and stored in a big plastic container. Only the child's drinking water was boiled. Boiled water was used to prepare the child's reconstituted milk and fruit juices. Her child had suffered diarrhea episodes since she was small. A lot of liquids, lemonades, oat gruel, and reconstituted milk had been given during diarrheal episodes. During recovery, oat gruel, reconstituted milk, and fruit juices had been given to the child.

The control mother's knowledge of food and water safety concepts was very good. Water was boiled in order to be consumed by the whole family during the day. That water was also used to make fruit juices and to prepare powdered milk. The child had had diarrhea six months ago. A lot of liquids, oral rehydration solution, a soup with rice, potatoes, rice water and carrots were given. Milk was stopped. Introduction of food based on milk as well as chicken broth was done after the diarrheal episode stopped.

The first three mothers knew what the oral rehydration solutions were and what the ingredients were to make these at home; however, the amounts of these ingredients were unknown.

Education program. During the whole program, mothers did not come on time; so each class had to be repeated for some of the mothers. Two, who worked as maids, had to leave early because of their jobs. These mothers were asked to come earlier for the following class; and the lesson, which they had missed, was repeated.

Key recommendations which were summarized the last day of class, were:

- Follow an antiparasite treatment for the family, if they could afford these medicines. All family members should have a parasite analysis at least twice a year;
- Boil water at least 30 minutes and avoid drinking raw water by bringing thermos with water to any place they go;
- Wash food utensils used to boil water with detergent;
- Keep utensils for boiling and storing water only for this purpose;
- Rinse drinking water glasses with boiled water before putting them upside down on a tray;
- Wash all of the food utensils and kitchen surfaces with detergent;
- Rinse vegetables and fruits with boiled water if eaten raw as well as the food utensils used to prepare food served without cooking;
- Do not eat outside of the home, unless you are very sure that the place boils water, serves fresh food, and rinses vegetables and fruits with boiled water;
- Make refreshments that children can take to school or any place else, so that they will not eat outside of the home;
- Cook food very well, especially seafood, even if ceviches will be made;
- Reheat leftover foods as if they were going to be cooked again at least 2-3 minutes; reheat food each two hours, if there is no refrigerator;

- Keep pets clean and have children not kiss them on their mouth, or give them food during meal times.
- Use oral rehydration solution that can save your child's life, if the child has diarrhea;
- Write down the amounts of the ingredients used to prepare oral rehydration solution, and put it in some place very easy to reach;
- Add bananas to the child's diet as well as milk diluted in acute stage or breast milk, and apples, lentil water, or quinoa water, during diarrheal episodes;
- Give a lot of carbohydrates, such as pasta, bread, crackers, noodles, potatoes, plantains, cassava, and rice mixed with chicken and vegetables as soon as the child recovers his appetite, after illness;
- Avoid giving children too fatty foods during diarrheal episodes;
- Give children milk for their growth, at least 2-3 cups per day.

Evaluation.

Post-test. The first part of evaluation was an oral survey of the mothers at the end of the last lesson . Tables of pre and post test results are shown in the Appendix.

Most of the questions from the first part of the program, food and water safety lesson, were answered correctly. These included answers to the questions about when to wash hands, what the steps to wash fruits and vegetables are, how to prepare powdered milk, and how to store and reheat leftover food. The questions about what kind of food utensils should be rinsed with boiled water and what should be done with the utensils used to boil water were frequently missed.

Answers to the questions from the second part of the survey, the parasite lesson, were very good. The answers to the questions from the third part of the survey, care during diarrheal episodes, were also very good; however, amounts of ingredients needed to prepare oral rehydration solutions at home were not known by any of the mothers. The questions from the last part of the survey were not answered. It was shown that most nutrition concepts were misunderstood.

Visits to homes of participants. The second part of the evaluation included visits to the families from both groups, the HACCP homes and those in the classes.

The visits were done to all of the urban families. During the visits, it was observed that most of the recommendations such as to place plastic baskets in high places, to boil water for more than 20 minutes, to wash fruits and vegetables with boiled water if to be eaten raw, to rinse utensils with boiled water when to be used to prepare raw foods, to separate utensils used to boil water, and to reheat leftover food well were being followed. It was also observed that glasses and cups used to drink boiled water were placed upside down on a tray and put either on the table or in the refrigerator. According to the families, there was not any problem in applying the recommendations; however, in the urban families' homes, there had been a water problem. Water-delivery trucks, in order to increase the price of a tank of water, did not want to pass by their houses. In addition, when one of the trucks came, the families had to buy 2 or 3 tanks, which were used in one or two days, because they did not care about the amount of water used per day. So, they were spending more money.

It was noted that nutrition concepts were misunderstood by urban families too. It is probable that either the program had more emphasis on food and water safety concepts or mothers and families did not have much knowledge about this topic. For results of the post-test about this topic, refer to the Appendix.

From the families, only one family had a child with diarrhea. His mother gave him chloramphenicol, advised by one of her relatives, because it was thought that the child had the beginning of typhoid fever. He was also given oral rehydration solution and was not hospitalized. During recovery, he was given apple juice, mashed banana, oat gruel without milk, a chicken broth, and a lot of lemonade. Milk was introduced two days later.

Of the mothers to whom the program was taught, three had had children with diarrhea recently. The doctor had told them that the diarrhea may have been caused by parasites or that the children had eaten something spoiled that day. None of them required hospitalization. Pedialyte, oral rehydration solution, and a lot of liquids were recommended. During recovery, a soup with milk, noodles and cheese; chicken broth; and oat gruel with apples were given to these children.

None of the mothers followed the parasite treatment. Fecal samples were taken from both groups (Tables 8 and 9). From the urban families, fecal samples were also taken one month after the last meeting with them (Table 8). From the mothers to whom the program was taught, fecal samples from the younger children were taken the last day of meetings with them. Fecal samples taken from HACCP families' children showed a decrease in the incidence of parasites; however, parasites continued to be present. The family's children that followed the antiparasite treatment showed a decrease in the quantity of parasites; however, fecal samples still showed Giardia lamblia, cysts of Entamoeba coli, and cysts of Entamoeba histolytica. From the family whose children only were given the antiparasite medicines, fecal samples did not show an abundance of parasites such as Entamoeba histolytica, Ascaris lumbricoides, and Giardia lamblia; but parasites such as Entamoeba coli, were abundant. There were no Chilomastix mesnilli and Hymenolepis nana. The children of the other HACCP families, who could not follow the antiparasite treatment, showed an abundance of

Giardia lamblia, cysts of Ascaris lumbricoides, Entamoeba histolytica, and Entamoeba coli. The child, who had diarrhea recently, belonged to one of these families.

From one of the three mothers in the class who submitted fecal samples, one child's sample showed an abundance of Giardia lamblia, cysts of Entamoeba coli, and cysts of Entamoeba histolytica. The fecal sample of the child of the second mother showed the presence of Giardia lamblia and cysts of Entamoeba coli. Children's fecal samples brought by the third mother showed an abundance of Giardia lamblia, Ascaris lumbricoides, cysts of Entamoeba coli, Entamoeba coli, and cysts of Entamoeba histolytica. A child in each of the three families had diarrhea recently.

Visits to both control mothers were done. The HACCP control family was visited one month after the last meeting with HACCP urban families. One of this family's children had had diarrhea one week earlier. The control mother was visited three weeks later after the last meeting with the mothers. The child had not had diarrhea lately.

The food preparation steps observed were similar among the families. The main hazard that could result in food containing pathogenic agents came from the length of time of holding, storing, and ineffective reheating of leftover food after the cooking process. Food was cooked in the morning to be eaten at lunch time; then it was held, reheated slightly, and served in the evening. Temperatures at the end of cooking reached boiling, which is enough to be lethal for any vegetative form of pathogenic bacteria; however, heat-resistant spores could survive. Food samples taken immediately after cooking showed no aerobic colonies, yeast, molds, total coliforms, or fecal coliforms. However, food samples from families 1, 2, and 3 taken 1, 1 1/2 and 3 hours after serving showed microbiological growth.

It is thought that besides the survival of spores during the cooking step, contaminated food utensils were used during the serving steps.

Holding leftover food at room temperature for long periods of times (3-6 hours) to be eaten at dinner or supper was a common habit among the HACCP families, including those who had refrigerators. This habit allowed the growth of vegetative forms, especially those from contamination after cooking. Food was not always reheated, and even those who did reheat leftover food did so only up to mild temperatures. The temperatures of the reheated foods were not measured, but it was observed that families ate leftover food immediately after it was served and the foods felt only warm to the hand. To reheat leftover food until it reaches the boiling temperature was one of the control measures recommended. Reheating leftover food each two hours was advised for those who did not have refrigeration.

Water was a serious concern among these families who had to get water from water delivery trucks. This water was used to wash children's bottles and fruits and vegetables to be eaten raw, as well as the utensils used to prepare foods. Results from raw water samples showed a high fecal contamination; none of the water samples, including these from the boiled supply, met the criteria for human consumption by The Ecuadorean National Standards Institute. Even when water was boiled by the families for at least 30 minutes, none of the boiled water samples met the criteria; contamination from utensils used to remove water was considered as a possible hazard in this step. In order to know how long a time was enough to meet the Ecuadorean standards for potable water, samples from water boiled for 10 and 15 minutes were taken; however, presence of aerobic bacteria continued. To boil water for more than 20 minutes and to keep the utensils used for this purpose separate were the control measures

recommended. It was also advised to rinse fruits and vegetables to be eaten raw as well as the utensils used to prepare them with boiled water.

Another hazard was related to the care and feeding of the children. It was observed that children generally played with pets in places where animal feces were on the floor, especially on the patio. Sometimes, children fed animals during the meal time, when animals were around the table. When children played outside the home, iced fruits and iced juices were eaten without washing the hands first. These foodstuffs were made by other families who lived in the same neighborhood. Another recommendation was to avoid having children eating outside of the home by making refreshments for the children to take to school or any other place. It was also advised that pets should be washed twice a week and also given parasite treatments.

Most of the mothers did not have the habit of washing their hands before starting to cook; this constituted one of the hazards during preparation of the oat gruel as a refreshment for young children. An additional hazard was the use of raw water for washing of bottles and food utensils. Another hazard was the time that refreshment was held at room temperatures. Food utensils used to prepare this gruel were washed with raw water; however, microbes should have been killed in the subsequent cooking step. Bottles were held in the room where the cats, flies and other insects were around them. The oat gruel was cooked early in the morning to be given when the children were hungry. After cooking for 1 1/2 hours, the oat gruel was held at ambient temperature. A sample from this gruel showed a high count of aerobic microorganisms, molds, and yeast. A raw carrot, which was washed with recycled raw water that was used to wash some food utensils, was given to the children. Food utensils were washed with the same water. Children did not wash their hands and the pets were always close to them.

During the meetings with HACCP families and mothers to whom the food and water safety program was taught, the importance of oral rehydration solution and its preparation at home were explained. After the lessons the names of the ingredients, but not the amounts, used to prepare oral rehydration solutions at home were known. It was advised to write down the amounts of these ingredients on a piece of paper and put it in a visible place. The UNICEF oral rehydration packages and Pedialyte bottles are also sold in most pharmacies in this country; besides having glucose and sodium chloride to restore blood volume and enhance sodium uptake, they also have potassium and sodium citrate to ensure the normal functioning of the cell and to return the blood pH to normal levels. Some of the newer rehydrating products, such as Alhydrate, are gruels made from rice flour which helps to also increase caloric intake during diarrhea.

Intestinal parasites are one of the main causes of diarrhea in children in developing countries where urbanization has created favorable conditions for parasite transmission. In urban and suburban zones of the cities, that were not planned for an enormous population growth, prevailing factors such as lack of basic services, streets without pavement, bad water quality, and overcrowding result in problems. The isolation of parasites from fecal samples taken from the youngest children for parasite analysis corroborated this statement.

Parasites, such as Ascaris lumbricoides, Entamoeba histolytica, Entamoeba coli, were found in children from both groups, the HACCP families and the mothers to whom the program was taught. There were similarities in the parasite findings between these two groups. In this Guayaquil area, urbanization has increased; the gravest problem in this city, lack of drinkable water, is becoming more difficult to solve every day. Sometimes, treatments for parasites are not given because most the carriers are asymptomatic. Hosts and parasites have established a biological equilibrium; however, when parasites find favorable

conditions, such as trauma, stress, or low nutritional status, the parasite attacks its carrier and symptoms, such as diarrhea, appear. Unfortunately, hosts often recover easily, become asymptomatic again, and think that they are cured. That is why it was necessary to include a parasite lesson in the program. The economic resource was the main limiting factor which did not allow the antiparasite treatments to be followed by the HACCP families. In the case of mothers to whom the program was taught, the main limiting factors were economic resources and time for low income mothers. Even though, it was advised to follow Metronidazole for 10 days to eliminate Entamoeba histolytica and Giardia lamblia, these parasites were still present in fecal samples from children whose family could follow the treatment. Treatment is not always enough to eliminate parasites, especially amoebas, because cysts always remain which will contribute to parasite multiplication. It was also advised that parasite treatment should be done only twice a year because some of the drugs cause gastric intolerance and nausea as side effects. However, due to the high prevalence of parasite infections because of contaminated food and water, it is sometimes recommended to give parasite treatment to children each 3 months. More research on the adequate dosage of parasitic drugs and treatment time as well as the time between one treatment and the next needs to be done, especially focused on the side effects of antiparasite drugs in children and parasite resistance.

Another main concern in this research was the care of children during diarrheal episodes and the introduction of foods during diarrhea and recovery. Diarrhea is considered the major cause of child mortality and morbidity in less favored areas in the world. When a diarrhea episode happens, malnutrition may develop or worsen; therefore, the cycle of deteriorating nutritional status and diarrhea may be established.

From the HACCP families and the mothers to whom the program was taught, some of the children, especially those under 2 years old, had had diarrhea recently. The mothers reported that most of the older children had had diarrhea when they were under 2 years old too. In a study done in another southwestern "suburbio" called "La Isla Trinitaria" by Dr. Luis Serrano, professor in the Medical school (Serrano, 1993), it was found that in 99 cases of diarrhea, 82% of the children were under 3 years old. The main reason why at this age children have diarrhea is that they start to eat solid food which generally is contaminated and put their hands and other objects into their mouths. This situation is worsened due to the poor environment around the families, especially the bad quality of water.

Introduction of solid food during diarrhea was another major focus in this educational program. Two approaches had to be analyzed in order to make a decision on content. One of these favors the delay in the introduction of food for 24-48 hours. During this time, clear liquids must be given, followed by breast feeding or diluted formula with a gradual increase of the milk formula concentration. This approach is practiced by most of the pediatricians in the United States. This approach also recommends for older children the banana, rice, apple and toast/tea diet (BRAT). It is based on the concept that many nutrients such as sugars, fat, and proteins are not well absorbed in the intestinal lumen because diarrhea-causing agents interrupt the normal mechanism of absorption by the villous cells. Lactose intolerance is frequently observed in children with diarrhea, especially that caused by rotaviruses, since the pathogenic agents affect the intestinal brush border where lactase enzymes are synthesized. Fat absorption may be also interrupted because of loss of bile acids, pancreatic injury, and intestinal mucosal abnormalities. In addition unabsorbed nutrients may cause osmotic diarrhea.

The second approach is to introduce food during diarrheal episodes, based on the increased need for calories during diarrhea for intestinal cell renewal. This approach is supported by much research about the effect of inclusion of mixed diets during acute diarrhea. One of these was done in Peruvian children who did not present carbohydrate malabsorption when the diet was eaten. However, some of them did present carbohydrate and fat malabsorption when diarrhea was caused by rotaviruses.

Information presented to the HACCP families and the mothers to whom the program was taught, was based on the two approaches and the families' and mothers' food habits. Most of the families and mothers reported giving a lot of liquids at the beginning of diarrhea episodes as well as rice water and juices such as lemonades and apple juice. As soon as the child's appetite returned, a soup with milk, cheese, rice and potatoes or a soup with milk, cheese, noodles and potatoes was given as well as chicken broth. These food habits during diarrhea were encouraged and some alternatives were given, such as other foods rich in carbohydrates and quinoa water or lentil water as alternatives for the rice water. The BRAT diet was especially encouraged when diarrhea episodes began. Milk for non-breast fed infants was advised to be stopped if the child continued with diarrhea and replaced with thick gruels. Fat rich food as well as beef and pork were discouraged during diarrhea episodes, since there was some research that had demonstrated the presence of fat in the stools.

Nutrition was another concern in this research. It was thought that teaching the four food groups could give the opportunity to choose alternatives from each group, as well as to know the daily recommendations. Unfortunately, nutrition concepts were misunderstood by both groups, possibly because of the limited nutrition concepts and because the whole program was focused more on food and water safety concepts and interventions which took most of the time.

Limiting factors. Recruiting mothers was another limiting factor. Even though several days were spent to learn mothers' working schedules, to explain the topics from the program to be taught, to offer free fecal analysis for the first three mothers that would attend the first class, and to offer them refreshments, it was very difficult to recruit class members. It was thought that the mothers' schedule was the main limiting factor for them to attend the program. Weekends were generally spent by some of the mothers for house cleaning or keeping track of their children's homework; the other mothers had to spend weekends working. Another time for classes was evening but this offered the same schedule problems for mothers.

Team participation is also very important in diffusing educational programs. If this program had been planned by a group of people, this stimulation might have reached different levels. For example, some of the team members could have talked to the employers where mothers worked so they would have permitted giving the program in the company or would have allowed mothers to leave their jobs early on Fridays with class scheduled late in the afternoon. Team members also could contact other people who are already doing community work. For example, Dr. Serrano's data about family's habits during diarrhea can be useful when team members are programming the intervention steps of the program.

Economic resources available for this study were another limiting factor. A sequence of fecal samples could not be analyzed from each child. More fecal samples could have given a more representative sampling and the potential to identify a greater variety of parasites. It also was not possible to identify the enterotoxigenic and enteropathogenic E. coli, rotaviruses, or other agents causing diarrhea in children. More materials, such as films or cleaning supplies for practice, could be purchased to improve the quality of the program. Additional

funds for transportation would have facilitated more visits. That would have helped in knowing what the problems were in attending the program, in meeting new families and communicating what the program was about, and in spreading the program to other families in new neighborhoods.

Having just one control family and one control mother limited this study. If this study had obtained at least 4 control families and 5 control mothers, a more accurate conclusion about the incidence of diarrhea in children present recently could be done. A longer time span for observation would also give a more complete picture.

From the observer's point of view, it was noted that families' habits could have been influenced by the presence of the observer. For example, it was said by one of the families that the meal prepared that day was especially for the observer. Also, several people need to be involved in the study, so that the work could have been shared. For example, food temperature of leftover food could have been measured by one person while another one could have noted the family's habits when father got home.

Recommendations. Education to change people's habits is a major key to reducing diarrhea in children, because it was demonstrated that food and water safety concepts, parasites, and care of children during diarrheal episodes were understood well, which was reflected in the positive changes seen in families' behavior during the visits to their homes. For example, it was observed that most of them had separated utensils used to boil water and glasses were put upside down on a tray. Also, it was observed that fruits and vegetables eaten raw were rinsed with boiled water. Most of the mothers asked their children to wash their hands before eating.

Education is a long process that needs time, economic resources, and people who are available to contribute to education in order for the greatest

number of people to be benefited. Changing people's habits is not easy overall when economic resources and poor environment are the greatest limiting factors. It was observed in low income families from both groups that the limiting factors have caused them to adjust their habits to what they can have. The problem of water could make people of any economic class change the habit of washing hands from often to less often, if water cannot be gotten from a pipe or it is gotten only twice a day and stored. It also resulted in the habit of having a small plastic container in the kitchen sink to recycle water for washing vegetables and fruits, food utensils, and sometimes hands.

There are many groups of people and organizations who have been promoting educational guides such as safety education for water supply and sanitation in communities, the golden rules of the World Health Organization to prepare food hygienically, and the care of diarrhea. These have been published by UNICEF, WHO, and The Planification Center and Social Studies in Ecuador. However, these guides need to be diffused to families because all of them were found only on private library book shelves, and none of them were known by the families. Lack of diffusion of these programs may be due to several factors. The number of copies printed is very limited. For example, one of them had only 500 copies. These copies are generally submitted in professional seminars. Programs need to be diffused by distributing the copies to people who perform different kinds of jobs, for example, teachers, leaders of the communities, doctors, health care center workers, community workers, nutrition community workers, and restaurant workers. They also need to be sent to private and government institutions as well as private and national libraries.

Even though many limiting factors were present, it is hoped that this research can contribute to multidisciplinary research and projects where the action, experience, and ideas from different professionals is respected and

applied through the diffusion of practical and easy messages that can be understood by the greater number of people. Professionals need to understand that socialization of education is very fundamental and can solve primary problems. For example, a primary solution could be to boil water, and secondary solution to take parasite treatment. Parasite treatment would not be effective if water is not boiled and other contamination prevented. The child is not isolated, he/she is an individual inside of the society; therefore, she/he interacts with their friends and friends' families.

Community participation is also encouraged by analyzing the community needs with those who live there. Community members can participate in teaching other community members the new appropriate measures in food and water safety practices and in tracking the problems in applying the interventions.

Research is also needed on the best and safest ways to handle water in delivery trucks from the place where it is treated so that it remains fit for human consumption. The contamination of water starts from the moment water is picked up in the trucks. Cleaning of the tank truck, washing of the people's hands, and cleaning of the truck's equipment used to deliver water are some of the topics that need to be included in the research. Since water samples from water boiled 10 and 15 minutes showed aerobic microbial growth, research on what spore-forming microbes related to foodborne illness could have survived in those samples and the time necessary to kill them needs to be done.

The HACCP process forces the educator to consider the on site (household) risks and to evaluate their seriousness. Based on these priorities, realistic changes can be recommended. These may include community changes, such as continued emphasis on the importance of a safe and adequate water supply, and educational programs. The monitoring and correction steps which complete the process in industrial applications are difficult at the household level.

However, health workers can document any change in the incidence of reported diarrheal illnesses. Reducing morbidity and mortality due to food and waterborne illnesses requires a team effort, which includes families and community workers.

Figure 1. Preparation of tuna soup in household of Guayaquil urban family 1

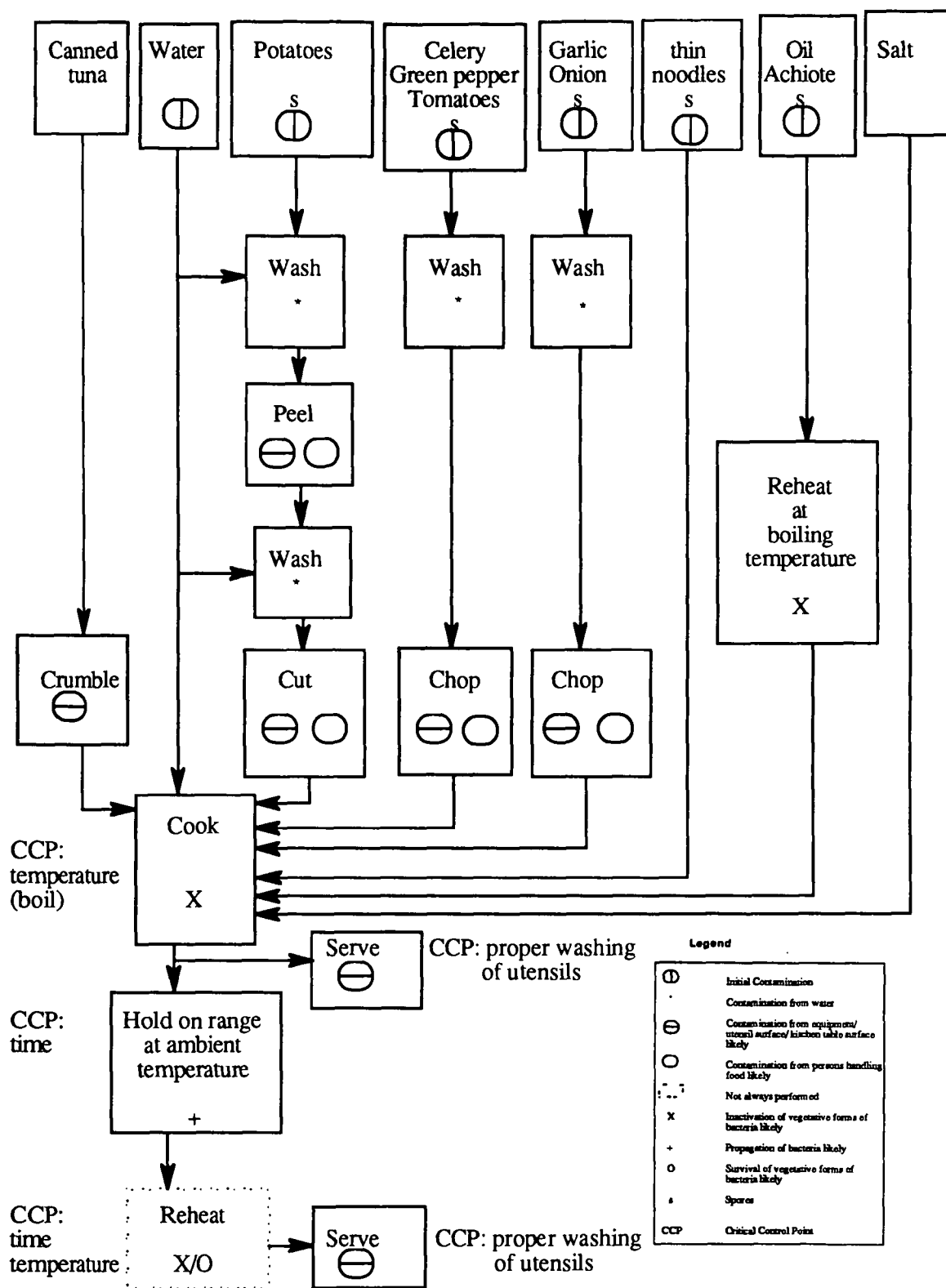


Figure 2. Preparation of tuna salad with potatoes in household of Guayaquil urban family 1

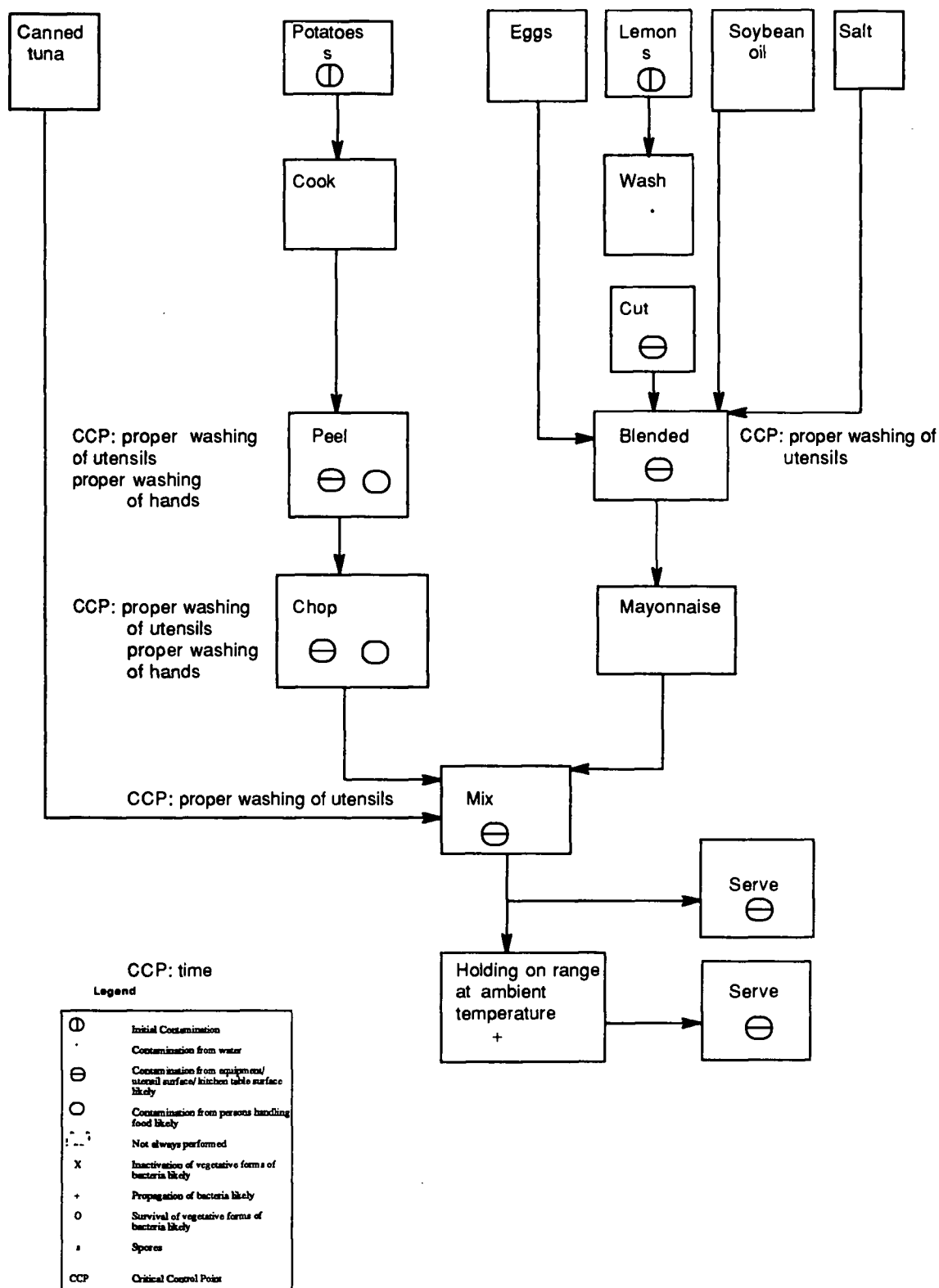


Figure 3. Preparation of bean soup with vegetables in household of Guayaquil urban family 2

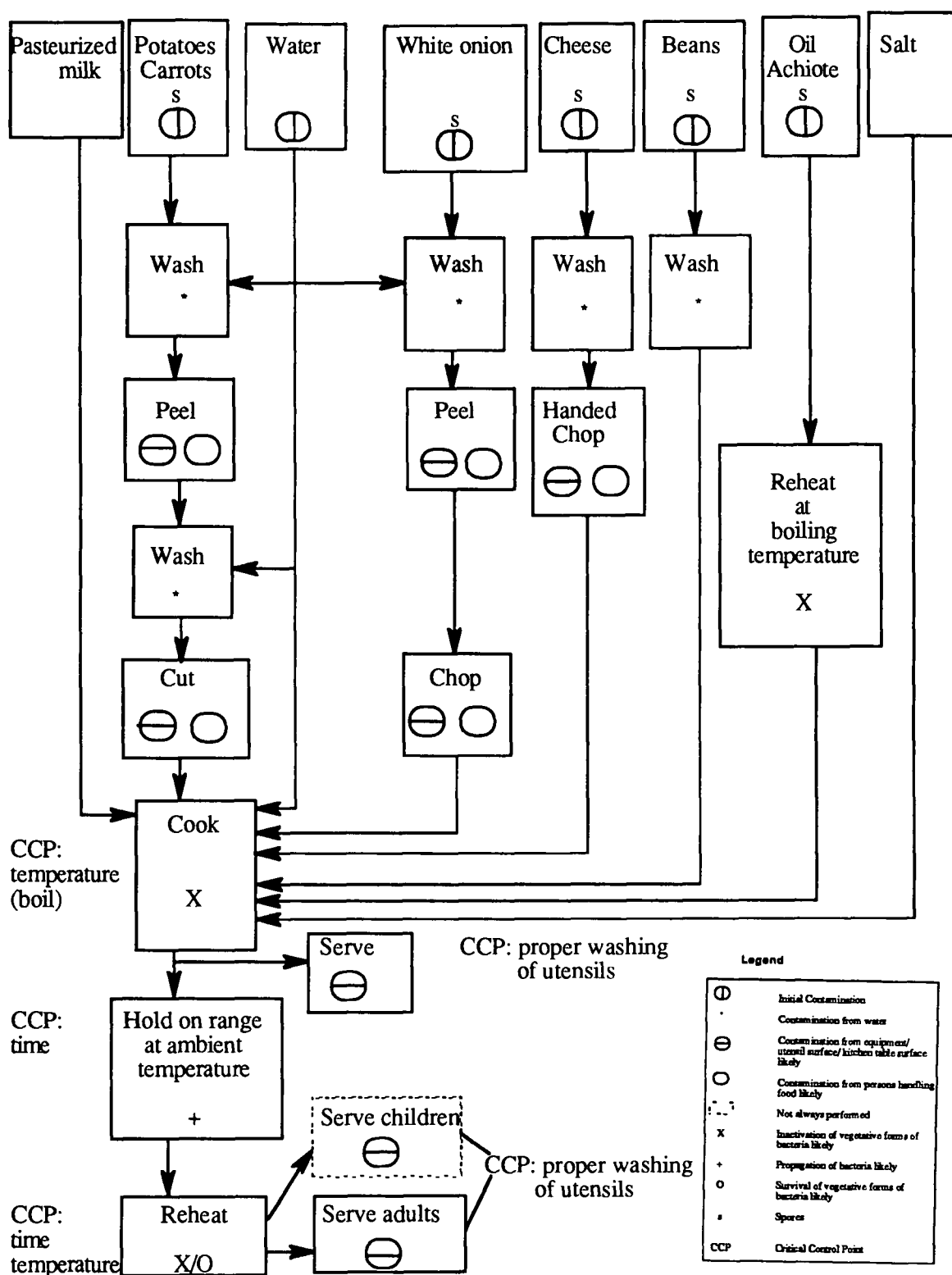


Figure 4. Preparation of oat gruel as a mid-morning refreshment for children in household of Family 2

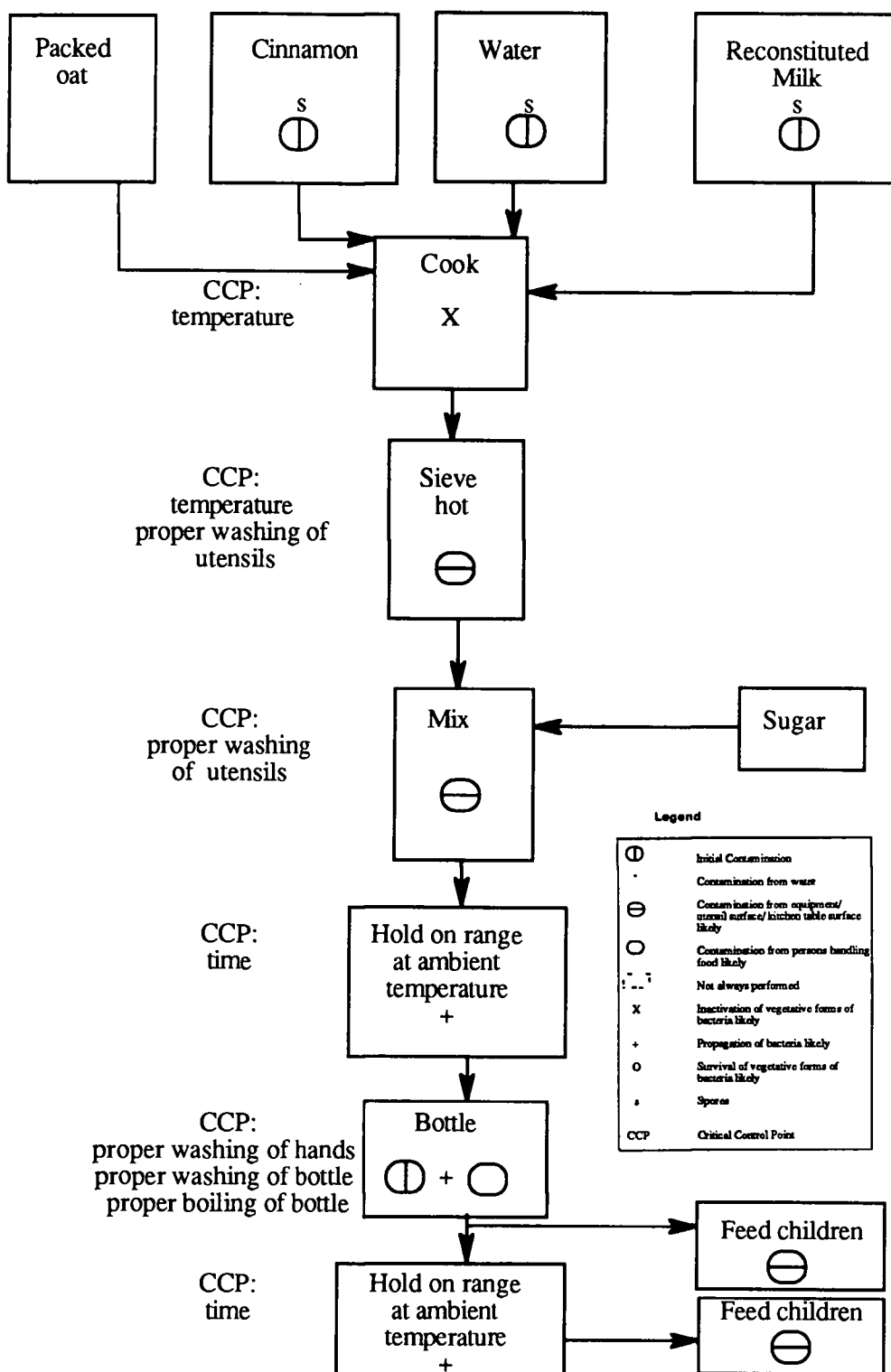


Figure 5. Preparation of meat stew with lentils in household of Guayaquil urban family 3

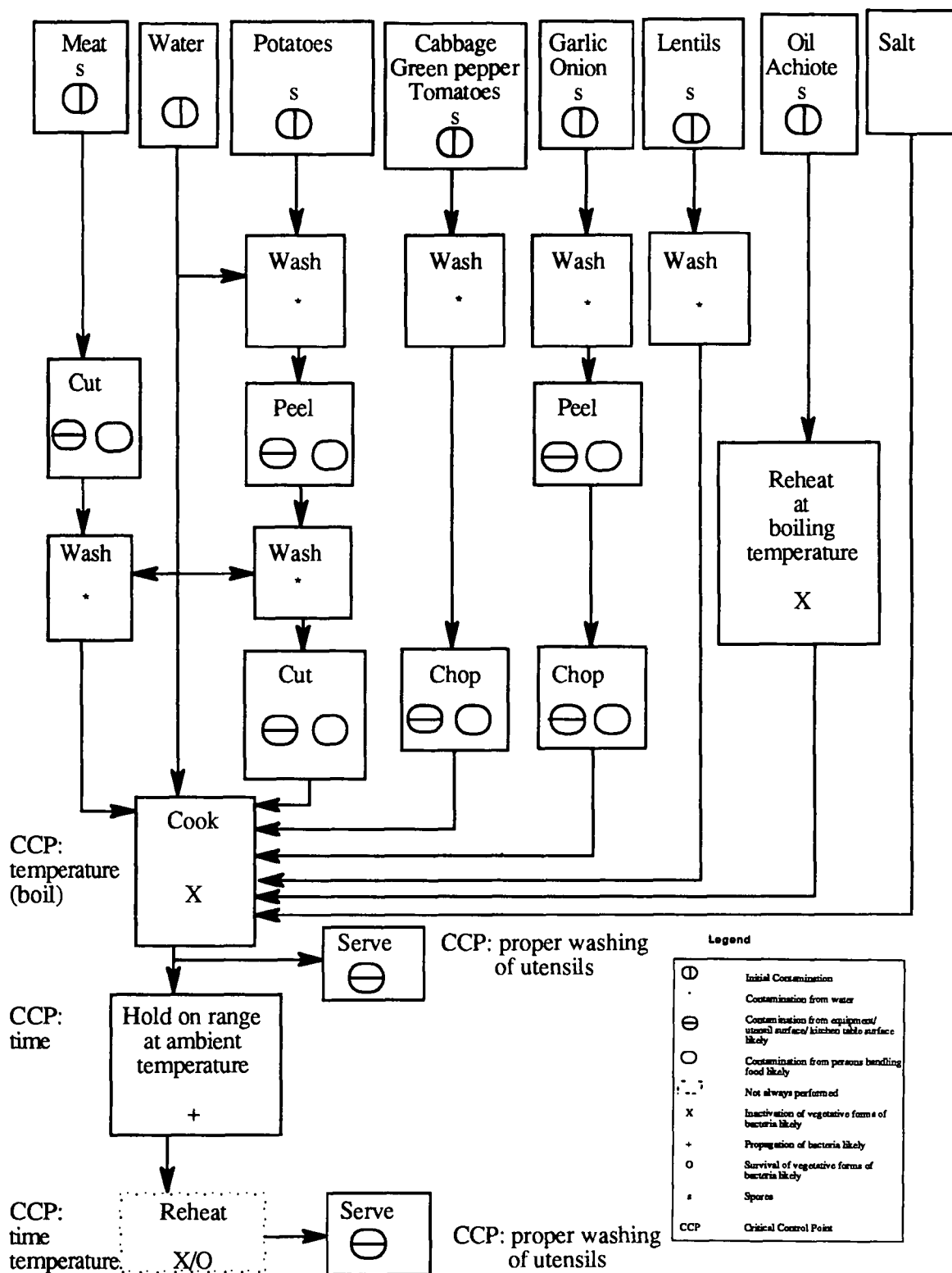


Figure 6. Preparation of meat stew with potatoes in household of Guayaquil urban family 4

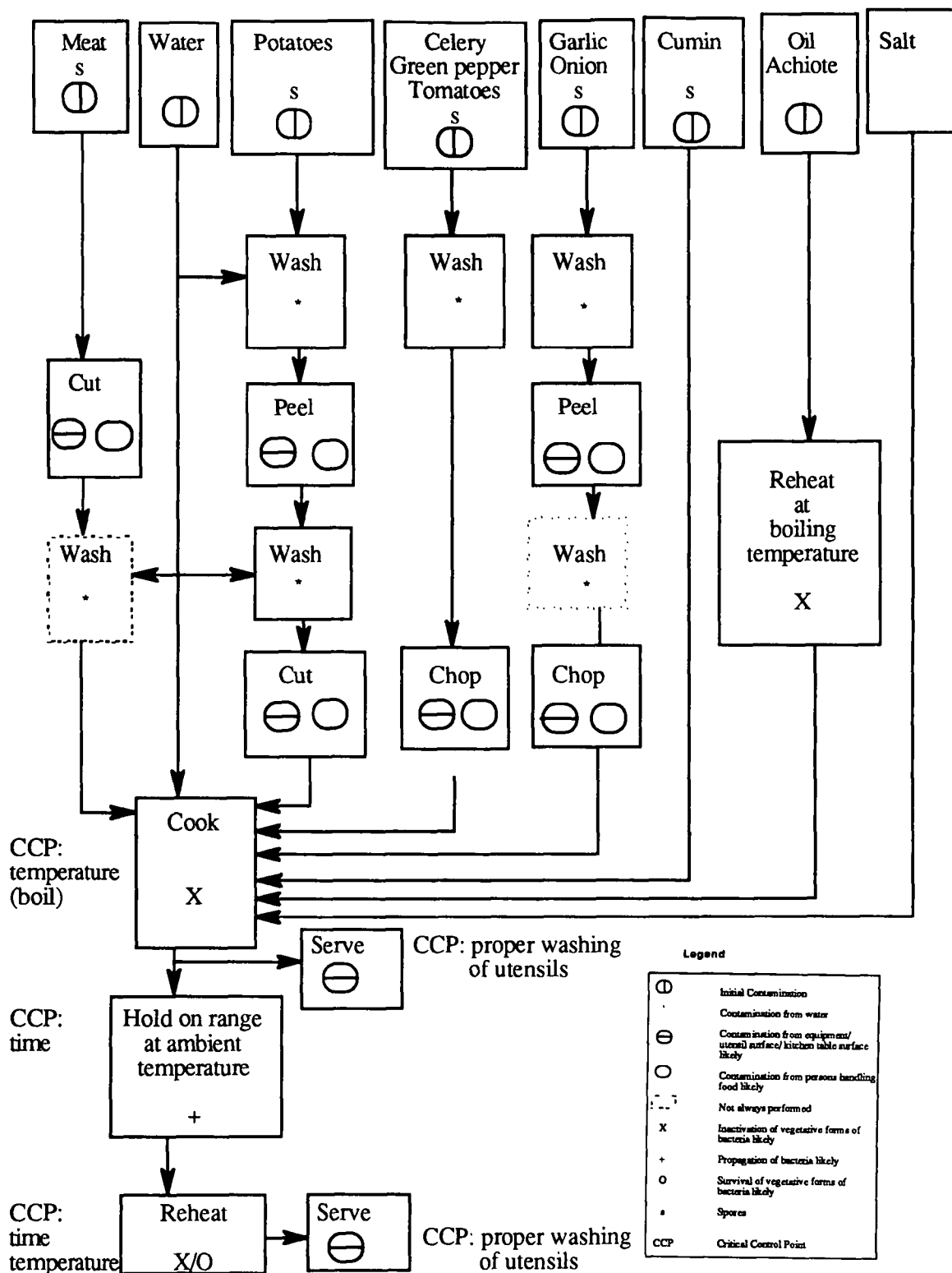


Figure 7. Critical control points of boiled water

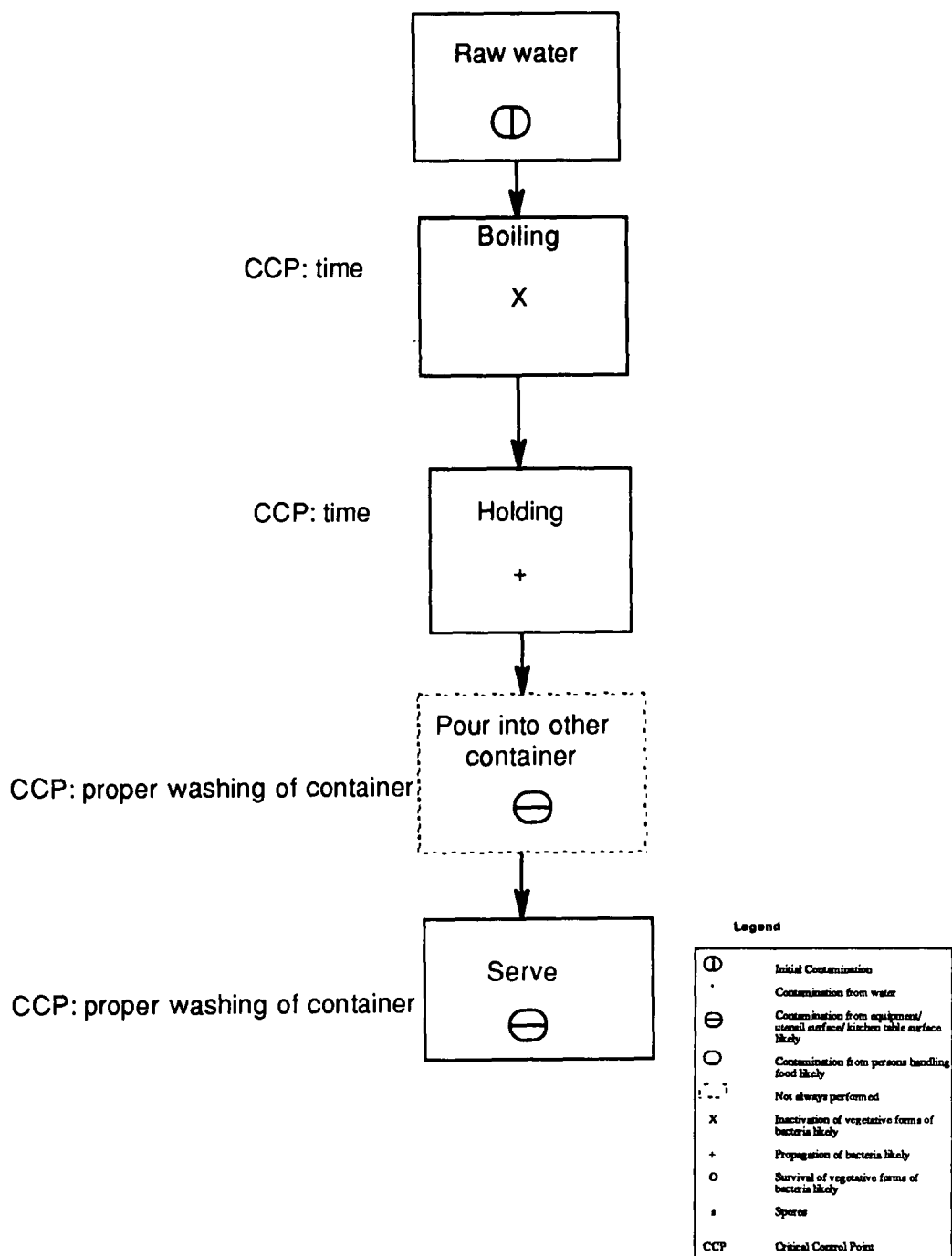


Table 5. Temperature and time information for critical control points for food during the cooking processes

Food	Cooking temperature of food (oF/oC)	Cooking time (minutes)	Serving temperature of food (oF/oC)	Holding temperature for leftover food (oF/oC)	Holding time (minutes)
Tuna soup	210/99	45	176/80	86/30	180
Bean soup vegetables cheese, and milk	208/98	50	176/80	86/30	360
Oat gruel	204/96	20	86/30	86/30	120
Meat stew w/lentils	210/99	40	176/80	86/30	180
Steamed rice	212/100	35	176/80	86/30	240
Meat stew w/potatoes	208/98	50	176/80	86/30	360
Steamed w/beans	210/99	45	176/80	86/30	360

Table 6. Aerobic total counts and molds and yeasts, total coliforms, and fecal coliforms in food cooked by urban families living in Guayaquil

Food Sample	Holding time after preparation (minutes)	Temperature °F/°C	Aerobic total counts (colonies/g)	Molds & Yeasts (colonies/g)	Total coliforms (colonies/g)	Fecal coliforms (colonies/g)
Tuna Soup	60	86/30	18,000	ND	ND	ND
Oat gruel	120	86/30	30,000	800	ND	ND
Meat stew w/lentils	180	86/30	30,000	50	ND	ND
Meat stew w/potatoes	15	176/80	ND	ND	ND	ND

ND No colonies in sample

Table 7. Results of testing for aerobic total count, total coliforms, and fecal coliforms in water samples from urban families living in Guayaquil

Family	Water samples	Aerobic total count (colonies/ mL)	Total coliforms (colonies/100mL)	Fecal coliforms (colonies/100mL)
1	raw-cooled	3,000	1,500	50
2	boiled	3,000	16	< 10
3	boiled 10'-cooled (a)	6,000	ND	ND
3	boiled 15'-cooled (a)	4,800	ND	ND
4	boiled	3,000	ND	ND

(a) Sampled without prior use of water after boiling

ND No colonies in sample

Table 8. Results of parasite analyses of stools of young children in the HACCP-study families taken the last day of meetings and one month later

Family	Parasites found at the end of HACCP process	Parasite found one month later
1	Cysts of <u>Entamoeba coli</u> Cysts of <u>Entamoeba histolytica</u> (abundant) Cysts of <u>Giardia lamblia</u> (abundant)	Cysts of <u>Entamoeba coli</u> Cysts of <u>Giardia lamblia</u> <u>Entamoeba histolytica</u>
2	Cysts of <u>Entamoeba coli</u> (abundant) Cysts of <u>Entamoeba histolytica</u> (abundant) <u>Ascaris lumbricoides</u> (abundant)	Cysts of <u>Entamoeba coli</u> (abundant) Cysts of <u>Entamoeba histolytica</u> (abundant) <u>Ascaris lumbricoides</u> (abundant) Eggs of <u>Ascaris lumbricoides</u>
3	Cysts of <u>Chilomastix mesnilli</u> Cysts of <u>Giardia lamblia</u> (abundant) <u>Hymenolepis nana</u>	<u>Entamoeba coli</u> <u>Entamoeba histolytica</u> Eggs of <u>Ascaris lumbricoides</u> <u>Giardia lamblia</u> (abundant)
4	Cysts of <u>Giardia lamblia</u> (abundant) Cysts of <u>Ascaris lumbricoides</u>	<u>Giardia lamblia</u> (abundant) Eggs of <u>Ascaris lumbricoides</u>

Table 9. Parasite analyses of stools of young children of the program mothers

Mother's Children	Parasites found
Mother 1	Cysts of <u>Giardia lamblia</u> (abundant) Cysts of <u>Entamoeba coli</u> Cysts of <u>Entamoeba histolytica</u>
Mother 2	Cysts of <u>Entamoeba coli</u> Cysts of <u>Giardia lamblia</u>
Mother 3	Cysts of <u>Giardia lamblia</u> (abundant) <u>Entamoeba coli</u> <u>Entamoeba histolytica</u> <u>Ascaris lumbricoides</u>

V. SUMMARY

Diarrhea is still one of the major causes of morbidity and mortality of younger children in developing countries. Urbanization has been considered one of the main factors in the creation of a poor environment, creating favorable conditions for pathogen transmission. The Hazard Analysis Critical Control Point system, which has been applied in the provision of safe food in commercial settings, was applied to homes. Hazard analyses of food preparation processes were conducted in four households of families living in a poor neighborhood in Guayaquil, Ecuador. The hazard analysis consisted of observing all of the steps in the food preparation process, measuring food temperatures at each step, and collecting food and water samples.

Temperatures reached during the cooking process were high enough to kill vegetative forms of foodborne pathogens; however, heat-resistant spores could have survived. Food was cooked to be eaten at lunch time, but leftover food was held for long periods of time at ambient temperature to be eaten at dinner or supper. Holding time was between 3-6 hours and the room temperature averaged 81 F (27 C), which allowed multiplication of vegetative forms from spores which germinated or from contamination from food utensils. Leftover food was eaten cold or reheated to warm temperatures.

Food samples were taken anytime of the day. Food samples taken right after cooking showed the absence of microorganisms. Food samples taken 1-3 hours after serving showed the presence of aerobic microorganisms, molds and yeast; however, fecal contamination was not observed in any of the food samples as judged by the absence of coliforms. Water samples were taken from water delivery trucks and from each family. None of these met the criteria of the Ecuadorean National Institute of Standards for human consumption. Raw water

from water delivery trucks showed the highest fecal contamination. Fecal samples from young children in these families were taken for parasite analysis. Parasites were found in all of the children; in addition, parasites were considered one of the main causes of diarrhea in these children.

A poor environment surrounded the families. Sewage systems were lacking; latrines were used for biological waste disposal. Habits were similar among the families. Hand washing before eating or preparing food was not a common habit. Raw contaminated water was used to wash food and utensils used in the process; this was identified as a major hazard in food preparation and serving. Food utensils used for boiling water were commonly used for other purposes too. Pets were kept inside of homes. The habit of drinking boiled water was practiced by only two of the families.

After critical points were identified, a meeting was held with each family in order to recommend corrective measures to improve the safety of each step of the cooking and serving processes which had been identified as a hazard. There was also discussion about oral rehydration therapy, introduction of food during diarrhea, and nutrition concepts. Also, parasite treatment was recommended according to the kind of parasite found in the fecal samples of the children. These recommendations were advised by Dr. Gina Quiñonez.

A third visit to each family was made one month later to observe which corrective measures were being applied. Fecal samples were again taken from the same children, as a way of evaluating the interventions. A control family was identified for this group. Diarrhea was present in only one child in the HACCP families, as well as in a child in the HACCP control family.

Based on the HACCP observations, a food and water safety program was designed and taught to five mothers coming to a Guayaquil Child Care Center. Two of the mothers were born in Guayaquil and were middle class. One of the

mothers had been living in this city for 18 years and was low income class. These three mothers had a good knowledge of food and water safety. The other two mothers had been living in Guayaquil for 3-4 years and were low income. These two mothers had little knowledge about food and water safety concepts. Therefore, the ethnic background was considered to be an important factor in the communication of educational programs. The program included a lesson on each of four topics: food and water safety; parasites; care during diarrhea, especially the importance of oral rehydration therapy and the introduction of food during diarrhea; and nutrition. Fecal samples from young children in these families were also taken. The presence of parasites was observed in all of the children.

At the end of the program a personal oral survey based on the material of the program was done. Food and water safety concepts, the parasite lesson, and the care during diarrhea were well understood. However, nutrition concepts were misunderstood. The same pattern was shown by the HACCP families.

A visit to each mother's home was done three weeks after the last meeting in order to know if their knowledge was being applied. A control mother was also identified for this group. Incidence of diarrhea in the children in these families was observed; the control mother's child had not had diarrhea lately. Even though diarrhea was present in children coming from both groups, HACCP families and child care center mothers, many positive changes in food and water sanitation behaviors were observed during visits to homes of both groups.

Food and water safety educational programs are encouraged. It has been emphasized that changing people's behavior is not easy but it is possible if appropriate educational material is used; for example, simple and few messages supported with practices. Participation of the community members is also

encouraged, since it has been proven that the effectiveness of projects is better when community members have participated.

BIBLIOGRAPHY

Alarcon, P., R. Montoya, J. Rivera, F. Perez, J. Peerson, and K. Brown. Effects of inclusion of beans in a mixed diet for the treatment of Peruvian children with acute watery diarrhea. Pediatrics. 90: 58-65, 1992.

Baltazar, J., T. Tiglao, and S. Tempongko. Hygiene behaviour and hospitalized severe childhood diarrhea: a case-control study. Bulletin of the World Health Organization. 71: 323-328, 1993.

Bellanti, J. Nestle Nutrition Workshop: Acute Diarrhea and Nutritional Consequences in Children. New York: Raven Press, 1984 pp. 150-180.

Berkow, R. and A. Fletcher. The Merck Manual. 15th edition. California: Merck Sharp & Dohme Research Laboratories, 1987, pp. 218.

Bezerra, J., T. Stathos, B. Duncan, J. Gaines, and J. Udall. Treatment of infants with acute diarrhea; what's recommended and what's practiced. Pediatrics. 90: 1-4, 1992.

Black, R., M. Merson, B. Rowe, P. Taylor, A.R.M. Alim, R. Gross, and D. Sack. Enterotoxigenic Escherichia coli diarrhea: acquired immunity and transmission in an endemic area. Bulletin of the World Health Organization. 59: 263-268, 1981.

Black, R., G. Lòpez de Romaña, K. Brown, N. Bravo, H. Grados, and H. Creed. Incidence and etiology of infantile diarrhea and major routes of transmission in Huascar, Peru. American Journal of Epidemiology. 129: 785-799, 1989.

Bread for the World Institute on Hunger and Development. Hunger 1993 Uprooted People. Maryland: Art Litho, 1993, pp. 171.

Briend, A. Is diarrhoea a major cause of malnutrition among the under-fives in developing countries?. European Journal of Clinical Nutrition. 44: 661-628, 1990.

Brown, K. and W. MacLean. Nutrition management of acute diarrhea: an appraisal of the alternatives. Pediatrics. 73: 119-125, 1984.

Brussow, H., H. Rahim, and W. Freire. Epidemiological analysis of serologically determined Rotavirus and enterotoxigenic Escherichia coli infections in Ecuadorean children. Journal of Clinical Microbiology. 30: 1585-1587, 1992.

Bryan, F. Hazard analysis critical control point: what the system is and what it is not. Journal of Environmental Health. 50: 400-401, 1988.

Bryan, F., P. Teufel, S. Roohi, F. Qadar, S. Riaz, and Z. Malik. Hazards and critical control points of food preparation and storage in homes in village and in a town in Pakistan. Journal of Food Protection. 55: 714-721, 1992.

Bryan, F., S. Mechanie, N. Mendoza, M. Moscoso, D. Taboada, O. Navarro, A. Bravo, and E. Guerra. Hazard analyses of foods prepared by migrants in a new settlement at the outskirts of Lima, Peru. Journal of Food Protection. 51: 314-323, 1988 a.

Bryan, F., S. Mechanie, M. Moscoso, O. Navarros, D. Taboada, N. Mendoza, E. Guerra, and B. Perez. Hazard analyses of foods prepared by inhabitants near Lake Titicaca in the Peruvian Sierra. Journal of Food Protection. 51: 412-418, 1988 b.

Bullen, C. and A. Willis. Resistance of the breast-fed infant to gastroenteritis. British Medical Journal. 3: 338-343, 1971.

Camacho, G. and A. Llorè. Las Diarreas: Prevención y Cuidado. Quito: Centro de Planificación y Estudios Sociales, 1989, pp. 1-21.

Caribbean Food and Nutrition Institute-Jamaica Ministry of Health. Nutrition Handbook for Community Workers in the Tropics. London: Macmillan in co-operation with Caribbean Food and Nutrition Institute, 1986, pp. 10-15.

Centro de Estudios de Población y Paternidad Responsable. Resumen del Estudio: Inmigración a Guayaquil. Quito: Departamento de Información-CEPAR, 1986, pp. 10-11.

Centro de Estudios de Población y Paternidad Responsable. Resumen del Estudio: Mortalidad Infantil en Menores de Dos Años. Quito: Departamento de Información-CEPAR, 1987, pp. 33-37.

Centro de Estudios de Población y Paternidad Responsable. Cuaderno Geográfico de la Provincia del Guayas. Quito: Departamento de Información-CEPAR, 1987, pp. 37-38.

Centro de Estudios de Población y Paternidad Responsable. Aspectos Socioeconómicos en el Proceso Demográfico. Quito: Departamento de Información-CEPAR, 1990, pp. 26.

Centro de Estudios de Población y Paternidad Responsable. Compendio Básico Poblacional. Quito: Ediciones culturales UNPSA, 1990, pp. 24.

Centro de Estudios de Población y Paternidad Responsable. Población, Salud y Nutrición. Quito: Créditos Editoriales, 1992, pp. 24.

Centro de Estudios de Población y Paternidad Responsable. Temas Poblacionales 4: Variables Biológicas y Supervivencia Infantil. Quito: Departamento de Información-CEPAR, 1990, pp. 8.

Chen, L. and N. Scrimshaw. Diarrhea and Malnutrition, 1st edition. New York: Plenum Press, 1983, pp. 113.

Creed, H., M. Fukumoto, M. Bentley, E. Jacoby, C. Verzosa, and K. Brown. Use of recipe trials and anthropological techniques for the development of a home-prepared weaning food in the central highlands of Peru. Journal of Nutrition Education. 23: 30-35, 1991.

Crompton, D. and L. Savioli. Parasitoses intestinales et urbanisation. Bulletin of World Health Organization. 71: 143-149, 1993.

Cukor, G. and N. Blacklow. Human viral gastroenteritis. Microbiological Reviews. 48: 157-179, 1984.

Donald, G. Chronic diarrhea in infants and children. American Family Physician. 29: 280-288, 1984.

El Universo. Setecientos mil Niños Desnutridos. Diciembre 7, 1992. Media Communication.

El Universo. Sesenta Por ciento de Ecuatorianos en Pobreza Crítica. Noviembre 15, 1992. Media Communication.

Esrey, S. and R. Feachen. Intervention for the control of diarrheal diseases: promotion of hygiene. Bulletin of World Health Organization. 133: 517-520, 1980.

Feachen, R. Interventions for the control of diarrhoeal diseases among young children: promotion of personal and domestic hygiene. Bulletin of the World Health Organization. 62: 467-476, 1984.

Fernandez, T. Texto de Medicina Tropical. 1era edición. Guayaquil: Impresiones de la Universidad de Guayaquil, 1990, pp. 57, 63, 83, 169-174.

Finberg, L., P. Harper, H. Harrinson, and B. Sack. Oral rehydration for diarrhea. The Journal of Pediatrics. 101: 497-499, 1982.

Food Laboratory Newsletter. Causes of diarrhea. 1986, 36-39 pp.

Glass, R. and A. Bransling-Bennett. Epidemic cholera in the Americas. Science. 256: 1524-1525, 1992.

Hatch, D., R. Vreuls, M. Toole, M. Moteetee, I. Monvang, C. Ngatane, D. Gittelman, and R. Waldman. The effective case management of childhood diarrhoea with oral rehydration therapy in the Kingdom of Lesotho. Journal of Epidemiology. 19: 1066-1071, 1990.

Hirschhorn, N. and W. Greenough III. Progress in oral rehydration therapy. Scientific American. 264: 50-56, 1991.

Instituto Ecuatoriano de Estadísticas y Censos. Análisis del V Censo de Población y IV de Vivienda. Quito: Talleres Gráficos del INEC, 1990, pp. 35-41.

Instituto Ecuatoriano de Normalización. Requisitos para Agua Potable. Norma No. 1108, 1983.

Jelliffe, D. and E. Jelliffe. Dietary Management of Young Children with Acute Diarrhoea. 2nd edition. Geneva: World Health Organization Publication, 1991, pp. 16-23.

Jenkins-MacLean, T. Lessons learned from a Third World water and sanitation project. Journal of Environmental Health. Special Issue: 35-38, 1991.

Lifshitz, F., P. Coello-Ramirez, G. Guitierrez-Topete, and M. Cornado-Cornet. Carbohydrate intolerance in infants with diarrhea. The Journal of Pediatrics. 79: 760-767, 1971.

Mata, L., F. Jimenez, and M. Cordon. Gastrointestinal flora of children with protein-calorie malnutrition. American Journal of Clinical Nutrition. 25: 1118-1126, 1976.

Mitchell, J. and M. Skelton. Diarrheal infections. American Family Physician. 37: 195-207, 1988.

Morrow, A., R. Reves, M. West, M. Guerrero, G. Ruiz-Palacios, and L. Pickering. Protection against infection with Giardia lamblia by breast-feeding in a cohort of Mexican infants. The Journal of Pediatrics. 121: 363-370, 1992.

North Carolina State University-Extension Service. Handle Food with Care to Stay Well-Teaching Series. North Carolina: North Carolina Agricultural Extension Services, 1981.

Nevárez, N. Leader of the Cooperative "La Paz". January-June, 1993. Personal Communication.

North Carolina State University-Extension Service. Keep Dry Foods in Closed Containers-Teaching Series. North Carolina: North Carolina Agricultural Extension Services, 1981.

Organización Mundial de la Salud-Organización Panamericana de la Salud. "Reglas de Oro" de la OMS para la preparación de los Alimentos. Washington, D.C., 1991.

Pinfold, J. Faecal contamination of water and fingertip-rinses as a method for evaluating the effect of low-cost water supply and sanitation activities on faeco-oral disease transmission. II. A hygiene intervention study in rural north-east Thailand. Epidemiology and Infection. 105: 377-389, 1990.

Quiñonez, G. Recommendations for anti-parasite medicines. Guayaquil, March-June, 1993. Personal Communication.

Schorling, J., C. Wanke, S. Schorling, J. MacAuliffe, M. DeSouza, and R. Guerrant. A prospective study of persistent diarrhea among children in an urban Brazilian slum. American Journal of Epidemiology. 132: 144-156, 1990.

Serrano, L. Trabajo de Educación para la Salud. Facultad de Medicina de la Universidad de Guayaquil, Junio 5, 1993. Personal Communication.

Standard Methods for the Examination of Water and Wastewater, 16th edition. 1983, pp. 861, 869-870.

U.S. Agency for International Development. Child Survival: A Sixth Report to Congress on the USAID Program, 1985-1990. Washington, D.C.: USAID Press, 1991, pp. 82.

UNICEF. Guía de Educación e Higiene para Sistemas de Abastecimiento de Agua y Saneamiento Ambiental. Washington, D.C., 1990, pp. 8-15.

U.S. Department of Agriculture-Extension Service. How Food Affects You. Washington, D.C.: Government Printing Office, 1977.

World Health Organization. Readings on Diarrhoea. Geneva: WHO Publication, 1992, pp 4, 12.

World Health Organization. Environmental Health and Diarrheal Disease Prevention. Geneva: WHO Publication, 1980, pp. 80-85

VII. APPENDICES

Appendix 1.

PRE-TEST: PERSONAL ORAL SURVEY OF MOTHERS TO OBTAIN DEMOGRAPHIC DATA AND TO ASSESS THEIR KNOWLEDGE OF FOOD AND WATER SAFETY.

A) DEMOGRAPHIC DATA

Mother's name:

Mother's age:

How long have you lived in Guayaquil:

How many children do you have:

Age of the children:

Mother's education:

B) FOOD AND WATER SAFETY CONCEPTS:

1) What is the first thing you do when you go to the kitchen?

2) Do you have a pet(s) in your kitchen? Do you play with it (them) while you are preparing food?

3) How do you prepare vegetables before eating; for example for a salad, and for a soup?

4) What do you do to a fruit before eating ? For example, do you eat the fruit after you bought it from open market because you are very hungry? How do you make fruit juice?

5) How do you eat eggs?

6) How do you eat seafood; tell me how you make ceviches?

7) How do you store food; for example, meats, eggs, milk, fruits, rice, etc.?

8) Where do you get your water?

9) How do you drink water?

- 10) If your child still drinks from a bottle, does she/he drink slowly or fast? if she/he drinks slowly, what do you usually do with the leftover food in the bottle?
- 11) How do you usually wash the child's bottles?
- 12) Have your children ever had diarrhea?
- 13) How often do they have diarrhea?
- 14) Have your children ever been hospitalized?
- 15) What is the first thing you do when they have diarrhea?
- 16) What food do you usually give your children when they have diarrhea?
- 17) Do you know about oral rehydration and how to prepare it at home?

C) ANSWER KEY

- 1) Wash hands.
- 2) No.
- 3) If making a salad with raw vegetables: wash first with raw water and then rinse with boiled water. If making a soup: wash with lots of raw water.
- 4) Wash it first with raw water and then rinse with boiled water. If making fruit juices, wash fruit with raw water and rinse with boiled water, and use boiled water.
- 5) Well cooked.
- 6) Seafood is well cooked, including ceviches.
- 7) Meat, eggs, and milk are stored in refrigerator; fruit and vegetables are preferably stored in the refrigerator, if there is no refrigerator, put fruits and vegetables in containers and store in a high place; store rice, beans, lentil, etc. in containers with lids and put in a high place.
- 8) From pipe, from water delivery trucks (optional).
- 9) Boiled water.
- 10) If she/he eats in less than 1 hour, put bottle in refrigerator or covered on the table. If more than 1 hour, prepare only the amount that the child usually eats, or discard the leftover food in the bottle. If child eats fast, no problem.

- 11) Wash with raw water and detergent, then sterilize with water until boiling temperature is reached.
- 12) Yes (optional).
- 13) Often (optional).
- 14) Yes/no (optional).
- 15) Administer a lot of liquid, juices, tea, herbal water, quinoa water, rice, water, lentil water, or oral rehydration solution.
- 16) Breast feed, diluted milk, thick gruels, soups made with milk, a lot of chicken broth, banana, apple, toast, rice, noodles, potatoes, plantain, cassava, bread, toast, any kind of high carbohydrate containing foods.
- 17) yes; to 1 liter of boiled water, add 8 teaspoons of sugar and 1 teaspoon of salt.

Appendix 2.

RESULTS OF THE MOTHERS' PRE-TEST

Question	Mother 1	Mother 2	Mother 3	Mother 4	Mother 5	Control mother
1	+	+	+	X	X	+
2	+	+	+	+	+	+
3	+	X/+	+	X	X	+
4	+	X/+	X/+	X/+	X/+	+
5	+	+	+	+	+	+
6	+	+	X/+	+	+	+
7	+	+	+	X/+	X/+	+
8	-	-	-	-	-	-
9	+	+	+	+	X/+	+
10	+	+	+	+	X/+	+
11	+	+	+	+	+	+
12	-	-	-	-	-	-
13	-	-	-	-	-	-
14	-	-	-	-	-	-
15	+	+	+	+	+	+
16	+	+	+	+	+	+
17	X/+	X/+	X/+	X/+	X/+	X/+

- + Question answered correctly according to key answer
- X Question answered incorrectly according to key answer
- X/+ Part of the question was answered correctly
- Optional answer

Appendix 3.

SUMMARY OF THE PROGRAM TAUGHT TO THE MOTHERS BASED ON HACCP OBSERVATIONS.

A) Food and water safety lesson

How to handle your food better

1) Store food in containers with lids and put in a high places.

2) Wash your hands:

- Before starting to prepare food.
- Before eating.
- After using the restroom.
- After changing your child's diaper.
- After blowing your nose or coughing.
- After playing with pets.
- After handling raw food that will be cooked, and before preparing food that will be eaten raw.

3) Wash all utensils that will be used:

- All utensils that will be used to cook food should be washed with raw water and detergent.
- All utensils used to prepare foods that will be eaten raw such as vegetable salads and fruit salads can be rinsed with boiled water after washing with raw water and detergent.
- Use detergent to wash all utensils.
- Rinse glasses that will be used to drink water with boiled water after washing with raw water and detergent.

- Place your drinking glasses upside down on a tray to avoid insect or rodent contamination, after washing with raw water and detergent followed by rinsing with boiled water.

- Clean all kitchen surfaces before starting to cook.

- Boil the child's bottle and keep it in the same pan covered with a lid.

- Keep all utensils used to boil water separate and use just for this purpose.

4) To prevent food spoiling:

- Serve hot food.

- Store leftover food covered in the refrigerator. if you have no refrigerator and need to wait a long time before eating, reheat leftover food after 2 hours to boiling temperatures and mix several times for 2-3 minutes. Do not forget to cover food after cooking.

- Keep foods such as beef, chicken, eggs, milk, or seafood in refrigerator. If you do not have one, ask somebody else to refrigerate these foods for you until they can be used.

5) To avoid illness from water contamination:

- Boil water at least 20 minutes. Do not drink water that has not been boiled.

- Separate food utensils for boiling water; use them only for this purpose.

- Remember to rinse foods that will be eaten raw with boiled water.

6) Other clues to good health:

- A child's food in the bottle should be eaten immediately; if your child drinks slowly, serve only enough food to be eaten within 1 hour, cover the bottle and avoid insect contamination.

- Whenever possible prepare food with utensils; do not use your hands.

- Bandage little cuts with Band Aids before starting to cook.

- Ask someone else to cook if you are ill.

- Cook foods such as, beef, pork, seafood, chicken, and eggs thoroughly.

- Make ceviches with well cooked, not raw, seafood.
- Avoid eating outside of the home. Eat only raw foods that have been rinsed with boiled water, that drinking water has been boiled or fruit juices that have been prepared with boiled water, and that food should be fresh and well cooked.
- Keep your children from eating outside of the home by preparing refreshments to take to school.
- Keep your pets clean. Do not let your children kiss your pets on their mouth or give them food during meal time.
- Ask your children to wear shoes.

Parasite lesson

- Parasites invade our intestinal tract.
- They do not allow us to utilize our food to for energy to work, dance, read , or to form new tissues, etc.
- They cause diarrhea, anemia, internal hemorrhage, and over a long period, malnutrition.

B) Parasite transmission:

- From person to person, because of contaminated hands.
- From water that has not been boiled.
- From animal to human.
- From using contaminated food utensils.
- From eating contaminated food.

Recommendations:

- It is recommended to do parasite analysis and follow parasite treatment if necessary for the whole family at least twice a year.
- Have your pets follow a parasite treatment too.

Main parasites found in children living in a urban neighborhood of Guayaquil:

- Giardia lamblia.

- Entamoeba coli.
- Entamoeba histolytica.
- Ascaris lumbricoides.
- Chilomastix mesnilli.
- Hymenolepis nana.

Medicine recommended for these parasites:

- Giardia lamblia: recommend Metradinazole (Flagyl); 250 mg a day, for children ; 500 mg a day for adults. Take this dose after meals 3 times a day, for 5 days.
- Entamoeba specie: recommend Metradinazole (Flagyl); 250 mg a day for children; 500 or 750 mg a day for adults, . Take this dose after meals 3 times a day, for 5-10 days.
- Ascaris lumbricoides: recommend Mebendazol; 100 mg a day, for children; 250 mg a day for adults. Take this dose after meals 3 times a day, for 3 days.

C) Care of child during diarrhea:

1) Why is the oral rehydration solution necessary?

- It helps your child to recover salts and fluids lost by diarrhea, fever, and vomiting.
- It helps your child to regain his/her appetite.
- It helps to save your child's life until your can get a doctor or go to a pharmacy.

Overall, it helps those who live far away.

2) How can you prepare the oral rehydration solution at home?

To 1 liter of boiled water, add 8 teaspoons of sugar and 1 teaspoon of salt.

3) How much of the oral rehydration solution should you give your child?

- It depends on your child's age and weight

- For a infant up to 1 year, whose weight is 2-7 Kg, recommend 1-2 glasses (8 oz, 237 mL) in 2 hours.
- For a child 1 to 5 years of age, whose weight is 7-15 Kg, recommend 3-5 glasses (8 oz, 237 mL) in 2 hours.
- For a child over 5 years old, whose weight is over 15 Kg, recommend 6-10 glasses (8 oz, 237 mL) in 2 hours.
- The oral rehydration solution should be given in small amounts every 15 minutes.

4) What kind of food should you give your child during diarrheal episodes?

- If your child is breast fed, continue breast feeding.
- Milk should be diluted. Soup made with milk, cheese, potatoes and/or noodles, and carrots should be given.
- If child's diarrhea persists, stop giving milk. Instead give him/her thick gruels made with plantain flour or soybean flour or oat with apple.
- Older children can eat bananas, rice, apples, and toast.
- Continue giving them rice water, quinoa water or lentil water.
- Give your child foods with high carbohydrate content to replace energy lost during diarrhea. Give them bread, cereal, rice, plantain, potatoes, cassava, crackers, noodles or any kind of pasta.
- if you think that beef, pork or eggs could hurt your child, you should replace these with soup made with chicken and foods high in carbohydrate such as noodles, bread, toast, gruel, cassava, plantain, or banana with diluted milk. Feed them chicken stew that contains potatoes, carrots, and thin noodles.
- Do not forget to give your child a lot of liquids or lemonade.

4) Nutrition lesson:

1) Food groups:

There are 4 food groups:

- Milk group includes powdered milk, condensed milk, evaporated milk.

Alternatives for milk are cheese, yogurt, and ice cream.

- Meat group includes beef, chicken, pork, fish, clam, shrimp or any other kind of seafood. Alternatives for the meat are eggs, dried beans, chochos, habas, quinoa, dried lentils, etc.

- Bread - cereal group includes any kind of bread, pasta, cereal, oats, plantain, cassava, corn, potatoes.

- Fruit - vegetable group includes any kind of fruit such as bananas, apples, grapes, watermelon, oranges, lemon, grapefruit, peaches; and any kind of vegetable such as tomatoes, carrots, cucumbers, celery, green vegetables, cabbage, lettuce, etc.

2) What is food important?

- The essential nutrients are: protein, minerals, vitamins, carbohydrate and fat.

- Protein helps to build and repair cells and tissues such as red cells, muscle cells, white cells, nerve cells, bone cells, skin cells. Food with a high protein content are found in the meat group and the milk group.

- The main minerals needed by our body are calcium and iron.

Calcium is needed to build bones; it is found in the milk group and in some vegetables such as the green vegetables.

Iron is needed by our body to transport oxygen to the cells. Iron is found in the meat group, in some vegetables such the green vegetables, and in some starchy foods such as whole wheat bread.

- The main vitamins needed by our body are vitamin A, B-complex vitamins, and vitamin C.

Vitamin A helps you to see better in the dark and to resist illness. Foods with a high vitamin A content are found in the fruit and vegetable group such as spinach, carrots, most of the green vegetables; and in the milk group.

B-complex vitamins help in digestion, better utilization of protein, and in neural function. B-complex vitamins are found mainly in meat, milk, chicken, cabbage, whole grain wheat, corn, and liver.

Vitamin C helps to maintain integrity in tissues. Vitamin C is found in the vegetable and fruit group, especially in citrus fruits such as oranges, lemons, pineapples, strawberries, etc. and green vegetables such as spinach, celery, etc.

- Carbohydrate and fat are needed by your body for energy to work, play, dance, read, study, etc. Carbohydrates are found in the bread - cereal group. Fat is found in such foods as vegetable oils as soybean oil, corn oil, etc., and in butter, peanuts, lard, pork, sausage, beef, poultry, ham, etc.

3) Daily recommendations for each food group:

- Milk group : count 1 cup of milk as a serving. It is recommended daily for:

Children under 9 years old: 2 to 3 cups of milk.

Children 9-12 years old: 3 or more cups of milk.

Teenagers: 4 or more cups of milk.

Adults: 2 or more cups of milk.

Pregnant women: 3 or more cups of milk.

Nursing mothers: 4 or more cups of milk.

Cheese can be used for part of the milk.

-Meat group: count as a serving 2 or 3 ounces of cooked lean meat, poultry, or fish such as a hamburger, chicken leg, or fish. Also 2 eggs or 1 cup of dried beans, 1 cup of dried lentils, 1 cup of habas, 1 cup of chocho. Two or more servings are recommended daily.

- Vegetable-fruit group: 4 or more servings are recommended.

Count as a serving 1/2 cup of raw juices, 1 banana or 1/2 grapefruit, 1 cup of chopped fruit. Eat oranges or other orange juice or citrus fruit to get your vitamin C requirement.

- Bread-cereal group: 4 or more servings are recommended.

Count as a serving: 1 slice of bread, 1/2 cup of cooked cereal, 1 ounce of ready to eat cereal, 1 cup of pasta, 1 cup of rice, 1 cup of cooked plantain, 1 cup of cooked cassava.

Appendix 4.

POST-TEST SURVEY ASKED MOTHERS AND HACCP FAMILIES AFTER THE PROGRAM WAS TAUGHT AND MEETING WITH THE FAMILIES

A) QUESTIONS:

- 1) According to what was taught, give me three points when you should wash your hands?
- 2) Give me the steps for washing fruits and vegetables?
- 3) How would you prepare powdered milk?
- 4) What food utensils would you rinse with boiled water?
- 5) Do you think that only your child has to drink boiled water? why?
- 6) What would you do with the utensils that you usually use to boil water?
- 7) How would you wash the utensils that you will use for cooking ?
- 8) If you have leftover food which you have to put away for your husband or any other family member who is coming 4 hours later, where would you put this leftover food? How would you serve it?
- 9) Why do you think parasites must be eliminated?
- 10) Do you think that only children should be given treatment for parasites?
- 11) How should you care for your pets?
- 12) What is the first thing you should prepare for your child when she/he has diarrhea, vomiting and/or fever?
- 13) How do you make oral rehydration solution at home?
- 14) What kind of food should you give your child when she/he has diarrhea?
- 15) Tell me three foods that contain carbohydrates?
- 16) If you do not have meat, what foods can be substituted?

17) How many glasses of milk are recommended for children and how many for adults?

B) KEY ANSWERS:

1) - Before preparing food.

- After using restroom.
- After changing a child's diaper.
- After coughing.
- After blowing your nose.

2) - Wash with raw water

- Rinse with boiled water

3) With boiled water

4) Utensils that will be used to prepare raw foods and fruit juices.

5) No, because it is contaminated with microbes such as parasites that can be transmitted through raw water.

6) Use them just for this purpose only; put the glasses upside down on a tray to avoid insect contamination.

7) Wash them with raw water and detergent.

8) Put it in refrigerator. If there is no refrigerator, reheat every 2 hours to boiling temperature. Serve leftover food hot.

9) Because they do not allow us to utilize our food. They cause anemia, cause internal hemorrhage, and over a long time, malnutrition.

10) No, the whole family . If one family member has parasites, it is probable that the whole family has them.

11) By washing them and giving them parasite treatment too.

12) Oral rehydration solution, a lot of liquids, rice water, tea, herbal water, quinoa water, lentil water.

13) To 1 liter of boiled water, add 8 teaspoons of sugar and 1 teaspoon of salt.

14) Diluted milk, breast milk, banana, banana with diluted milk mixture, apple, rice, toast, soup with milk, chicken broth, noodles, potatoes, plantain, thick gruels, cassava and any kind of high carbohydrate food.

15) Breads, potatoes, plantain, cassava, cereals, crackers, pasta, noodles, soybean flour, banana flour, any kind of flour.

16) Dried beans, dried lentil, habas, chocho.

17) At least 3 glasses of milk for children and 2 glasses of milk for adults.

Appendix 5.

RESULTS OF THE HACCP FAMILIES' POST-TEST.

Question	Family 1	Family 2	Family 3	Family 4
1	+	+	+	+
2	+	X/+	+	X/+
3	X/+	X/+	+	X/+
4	X/+	X	+	X
5	+	+	+	+
6	+	+	+	X
7	+	+	+	+
8	+	+	+	+
9	+	+	+	+
10	+	+	+	+
11	+	+	+	+
12	+	+	+	+
13	X	X	X	X
14	X	X	X/+	X
15	X/+	X	X/+	X
16	X	X	X	X
17	X/+	X	X	X

- + Question answered correctly according to key answer
 X Question answered incorrectly according to key answer
 X/+ Part of the question was answered correctly

Appendix 6.

RESULTS OF THE MOTHERS' POST-TEST

Question	Mother 1	Mother 2	Mother 3	Mother 4	Mother 5
1	+	+	+	+	+
2	+	+	+	+	+
3	+	+	+	+	+
4	+	X/+	X/+	X	X
5	+	+	+	+	+
6	+	X/+	+	X/+	X/+
7	+	+	+	+	+
8	+	+	+	X/+	X/+
9	+	+	+	+	+
10	+	+	+	+	+
11	+	+	+	+	X/+
12	+	+	+	+	+
13	X	X	X	X	X
14	+	+	+	+	+
15	X/+	X/+	X/+	+	+
16	X	X/+	X/+	X	X
17	X/+	X	X/+	X	X/+

- + Question answered correctly according to key answer
 X Question answered incorrectly according to key answer
 X/+ Part of the question answered correctly.