THE POTENTIAL MICROBIOLOGICAL HAZARDS AND CRITICAL CONTROL POINTS OF SALADS SOLD BY A STREET VENDOR AND SALAD BAR IN A SUPERMARKET

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ABSTRACT

The descriptive study with participatory observation was designed to analyze potential microbiological hazards arising in the process of salad preparation and display. The study was based upon the investigation of ready-to-eat salads offered by a selected street vendor and in a selected supermarket in Bangkok. The quantitative analysis was aimed at determination of Critical Control Points (CCPs) by using decision tree diagrams recommended by World Health Organization.

A microbiological quality survey of salad sold by a street vendor showed that 7 out of 12 ingredients, including cucumber, lettuce, cabbage, red kidney bean, barley, boiled sweet potato and corn were contaminated by microbiological indicators. *Vibrio cholerae* non O1/non O139 and *Clostridium perfringens* were found in lettuce whereas *Salmonella* group C was found in cabbage and *Salmonella* group E was present in barley. After 2 to 3 hours of display, the amount of microbiological indicators increased in almost all of the salad ingredients and *Staphylococcus aureus* was found in barley. Furthermore, microbiological-hazard results of salad bar in the supermarket showed that 14 out of 23 ingredients, including tomato, lettuce, cantaloupe, red cabbage, cabbage, carrot, baby corn, asparagus, potato, taro, pumpkin, mixed vegetables, potato salad, coleslaw and apple salad were contaminated by microbiological indicators. However, pathogenic organisms were not found in any of the ingredients. After 2 to 3 hours of display, the amount of microbiological indicators increased in almost all of the salad ingredients. Based on the decision tree analysis results, this study indicates that the steps of cutting, slicing, cleaning, boiling and displaying constitute the Critical Control Points (CCPs) of salad preparation.

In addition to these findings, the study provides in-depth insight into how the Hazard Analysis Critical Control Point (HACCP) can be implemented in subsequent steps of ready-to-eat salad preparation.

KEY WORDS : MICROBIOLOGICAL HAZARD /CRITICAL CONTROL POINT /SALAD /STREET VENDOR /SUPERMARKET

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อันตรายจากจุลชีพและจุดวิกฤตที่ต้องควบคุมของสลัดที่จำหน่ายโดยผู้ขายริมบาทวิถีและสลัดบาร์ในซุปเปอร์มาเก็ต (THE POTENTIAL MICROBIOLOGICAL HAZARDS AND CRITICAL CONTROL POINTS OF SALADS SOLD BY A STREET VENDOR AND SALAD BAR IN A SUPERMARKET)

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บทคัดย่อ

การศึกษาครั้งนี้เป็นการวิจัยเชิงพรรณาและใช้การสังเกตแบบมีส่วนร่วม เพื่อวิเคราะห์อันตรายทางจุลชีพในกระบวนการเตรียมสลัดรวมไปถึงการวางจำหน่าย กลุ่มตัวอย่างในการวิจัยคือ สลัดจาก 2 แห่ง สลัดที่วางจำหน่ายริมบาทวิถีและสลัดบาร์ในซุปเปอร์มาเก็ต เขตกรุงเทพมหานคร ทำการศึกษาเชิงปริมาณเพื่อหาว่าขั้นตอนใดในการเตรียมสลัดเป็นจุดวิกฤตที่ต้องควบคุมโดยใช้แผนผังการตัดสินใจ (Decision tree) ที่เสนอแนะโดยองค์การอนามัยโลกเป็นเครื่องมือช่วยในการวิเคราะห์

ผลการศึกษาพบว่า 7 ใน 12 องค์ประกอบของสลัดที่จำหน่ายริมบาทวิถี คือ แตงกวา, ผักกาดหอม, กะหล่ำปลี, ถั่วแดง, ข้าวบาร์เลย์, มันต้ม และข้าวโพดต้ม มีการปนเปื้อนของตัวชี้วัดทางจุลชีพและพบ *Vibrio cholerae* non O1/non O139 และ *Clostridium perfringens* ในผักกาดหอม, พบ *Salmonella* group C ในกะหล่ำปลีและ *Salmonella* group E ในบาร์เลย์ หลังจากวางจำหน่ายไปแล้ว 2 ชม. แต่ไม่เกิน 3 ชม. พบว่าปริมาณตัวชี้วัดทางจุลชีพเพิ่มขึ้นและพบ *Staphylococcus aureus* ในบาร์เลย์ สำหรับสลัดบาร์ในซุปเปอร์มาเก็ต 14 ใน 23 ขององค์ประกอบสลัด คือ มะเขือเทศ, ผักกาดหอม, แคนตาลูป, กะหล่ำปลีม่วง, กะหล่ำปลี, แครอท, ข้าวโพดอ่อน, หน่อไม้ฝรั่ง, มันฝรั่ง, เผือก, ฟักทอง, ผักรวมต้ม, สลัดมันฝรั่ง, โคสลอว์ และ สลัดแอปเปิ้ล ตรวจพบตัวชี้วัดทางจุลชีพ แต่ไม่พบเชื้อก่อโรค และพบว่าหลังจากวางจำหน่ายไปแล้ว 2 ชม. แต่ไม่เกิน 3 ชม. ตัวชี้วัดทางจุลชีพมีปริมาณเพิ่มขึ้น, เมื่อใช้แผนผังการตัดสินใจ พบว่า ขั้นตอนการ ตัด เฉือน ล้าง ต้ม และวางจำหน่าย เป็นจุดวิกฤตที่ต้องควบคุมในกระบวนการเตรียมสลัด

ข้อเสนอแนะสำหรับงานวิจัยในอนาคต ศึกษาเชิงลึกในการนำวิธีการวิเคราะห์อันตรายและจุดวิกฤต (HACCP) มาใช้ในกระบวนการเตรียมสลัด

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CONTENTS

CONTENTS (CONTINUED)

CONTENTS (CONTINUED)

LIST OF TABLES

LIST OF TABLES (CONTINUED)

LIST OF TABLES (CONTINUED)

LIST OF FIGURES

LIST OF FIGURES (CONTINUED)

LIST OF FIGURES (CONTINUED)

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CHAPTER I
INTRODUCTION

1.1 Background

During recent years there has been an increasing emphasis on the importance of consumption of fresh vegetables for the healthy diet (1). From this reason, fresh prepared salads are highly popular items due to fitness of today's consumers. Many different styles of salads are commercially available in the market. There are many types of salads, usually served with salad dressing such as mayonnaise. Some types consist of ingredients mixed with dressing. Some types are sold in supermarket which consumer can choose or order the types of salad ingredients.

Salads are ready-to-eat food, normally consumed without any heat treatment, and therefore the possibility of food poisoning exist (2). The processing of salads is moved father away from the ultimate consumer, increasing the time and distance between processing and consumption and also increasing the potential health risks to consumers (3). The potential of mayonnaise based salads to become contaminated with pathogenic microorganisms can be high because of extensive handling during preparation and service by food service personnels(4). Food-borne illnesses have been traced to fresh salad products and raw produce (3). The potential sources of pathogenic bacteria in fresh salads include ingredient (particularly raw produce), plant workers, and the processing environment. A majority of food-borne illnesses have occurred in foodservice operation (5). A relatively new approach to the prevention and control of food borne disease is the Hazard Analysis Critical Control Point (HACCP) system.

HACCP is a systematic approach in identifying, evaluating and controlling food safety hazards(6). This system seeks to identify the hazards associated with any stage of food production, processing or preparation, assess the related risks and determine the operation where control procedures will be effective. HACCP composes of hazard analysis and determines critical control point. Therefore, the researcher is interested in identifying what the microbiological hazards in step of preparation and

display of Salads are and also determining which production steps are the critical control points required to control identified hazards.

1.2 Objective

1.2.1 General objective

- To study the microbiological hazards in step of preparation, time of salads displaying from street vendor and salad bar in supermarket and determine the Critical Control Points (CCPs) of salads from both salad sellers.

1.2.2 Specific objective

- To analyze the amount of microbiological hazards in steps of salad preparation and mayonnaise dressing
- To analyze the amount of microbiological hazards that related to the time of salad displaying
- To determine the Critical Control Points (CCPs) of salads from street vendor and salad bar in supermarket.

1.3 Variables

1.3.1 Independent variables

- Production steps of salad preparation and mayonnaise dressing
- The time of salad displaying

1.3.2 Dependent variables

The amount of the microbiological hazards (Coliform bacteria, *Escherichia.coli*, *Staphylococcus aureus*, *Salmonella spp*., *Clostridium perfringens, Vibrio cholerae* ,Yeast and Mold,)

1.4 Definition of terms

1.4.1 Ready-to-eat is defined as the status of the food being ready for immediate consumption at the point of sale (7)

1.4.2 The preparation steps are the steps of preparing ingredient of salads and mayonnaise dressing that may involve several processes such as washing, rinsing, peeling, chopping, slicing and mixing the ingredient of mayonnaise dressing

1.4.3 The displaying step is the operation after preparing the ingredient of salads and mayonnaise dressing to show the finished salads to consumers.

1.4.4 Microbiological hazards are the unacceptable level of microbial in salad that expressed by microbiological indicators and pathogenic organisms.

1.4.5 Microbiological indicators are specific microbial that can be indicator of food contamination that may be cause food borne disease expressed by coliform bacteria *Escherichia.coli*, yeast and mold.

1.4.6 Pathogenic organisms are bacteria that cause food-borne disease including *Salmonella spp*., *Staphylococcus aureus*, *Clostridium perfringens* , *Vibrio cholerae*.

1.4.7 Mayonnaise dressing is a smooth creamy, semi-solid emulsified dressing, compounding of egg, oil, vinegar, pepper, sugar and salt used in dressing salads.

1.4.8 Street vendor is the food seller who sell food and hawkers especially in streets and other similar public place for immediate consumption or consumption at a later time without further processing or preparation.

1.4.9 Food contact surface are any surfaces of equipments, utensils or preparation areas that contact with the food and ingredients during preparation and displaying.

1.4.10 Critical Control Point (CCP) is a step at which control can be applied and is essential to present or eliminate a food safety hazard or reduce it to an acceptable level(8)

1.5 Scope of the study

1.5.1 The microbiological hazards are coliform bacteria, *Escherichia.coli*, *Staphylococcus aureus*, *Salmonella spp*., *Clostridium perfringens* , *Vibrio cholerae,* Yeast and Mould.

1.5.2 The microbiological hazards were studied in the step of preparation and at the time of salad displaying from both street vendor and salad bar in supermarket.

1.5.3 The acceptable level or unacceptable level of contamination was determined by the comparison of the results at each step using the microbiological standard of The Department of Medical Science, Ministry of Public Health(9).

1.5.4 The Critical Control Points (CCPs) were determined by using the tool decision tree recommended by WHO. The critical limit and control measure were excluded from the study.

1.5.5 The mayonnaise dressing without vinegar oil were only be studied.

1.5.6 The ingredients of mayonnaise dressing from street vendor were collected to analyze the microbiological hazards. However the finished mayonnaise products from supermarket were not collected to analyze for microbiological hazard because they were already approved by Food and Drug Administration of Thailand.

1.5.7 The samples were collected 3 times during the study. In each time all ingredients were taken at each step of salad preparation. The sampling was done at a time interval. First, the sample was collected immediately after preparation of salads. Second, the sampling was collected after 2 hours of displaying within 3 hours.

1.6 Limitation of study

1.6.1 This study aims to analyze microbiological hazards and determine the critical control point of salads preparation. It is important to receive participation from food sellers. Therefore the purposive sampling technique was applied in this study. The street vendor who sells salad in the area nearby the Victory Monument and the salad bar in supermarket were selected according to their cooperation.

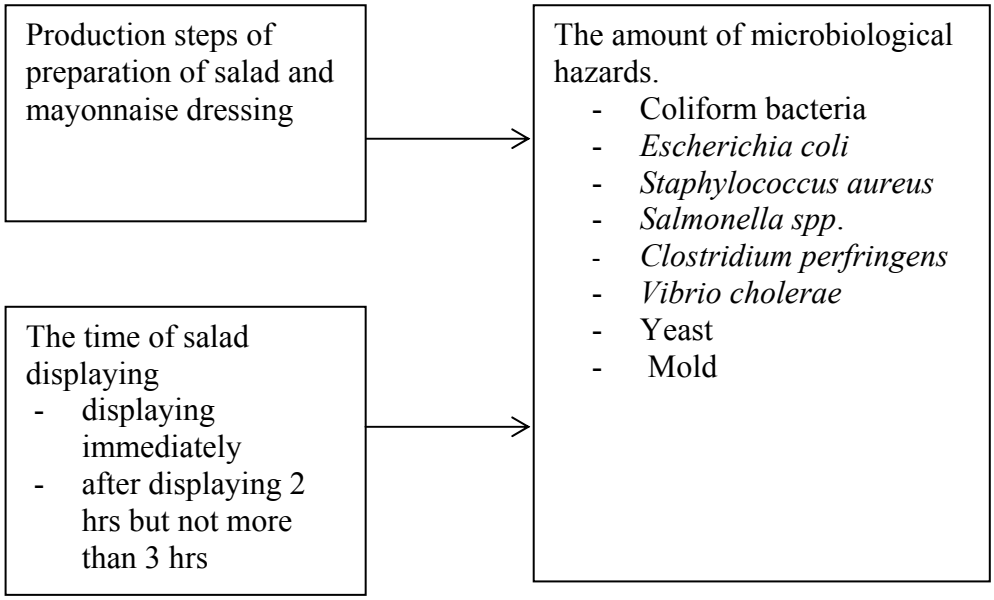
1.7 Expected Outcome

1.7.1 The amount of microbiological hazards in the steps of preparation and displaying of salads from street vendor and salad bar in supermarket will be determined.

1.7.2 The Critical Control Points from the steps of preparation and displaying of salad from both places will be explained.

1.7.3 The results will be used as the basic information to improve hygienic condition of salad preparation and displaying by using Hazard Analysis Critical Control Point system (HACCP).

1.8 Conceptual framework



CHAPTER II
LITERATURE REVIEWS

2.1 Hazard Analysis and Critical Control Point (6,8,9,10,11,12)

Traditionally, the Hazard Analysis and Critical Control Point (HACCP) methodology has been considered to be a food safety management system. HACCP systems are designed to prevent the occurrence of potential food safety problems. This is achieved by assessing the inherent hazards, defined as biological, chemical or physical agents or operations. Then attributable to a product or a process, determining the necessary steps that will control the identified hazards and implementing active managerial control practices to ensure that the hazards are eliminated or minimized.

HACCP offers two additional benefits over conventional inspection techniques. First, it clearly identifies the food establishment as the final party responsible for ensuring the safety of the food it produces. Secondly, a HACCP system allows the regulatory agency to move comprehensively determine an establishment's level of compliance.

2.1.1 Seven principles of HACCP

Principle 1 Conduct a hazard analysis

Determine the possible hazards consist of biological hazards, chemical hazards and physical hazards. The hazards exist for a specific food or ingredient associated at all stages to final product ready for consumption from pathogenic microorganisms and their toxins.

Principle 2 Determine the Critical Control Points (CCPs)

To control microbiological hazards in a food production system. A CCP is any point or procedure in a specific food system where effective control must be implemented in order to prevent hazards

Principle 3 Establish critical limits

To control microbiological hazard at each identified CCP, it is necessary to set up critical limits. One or more critical limits may be necessary at each CCP, and all of them should be present to ensure that hazards are under control.

Principle 4 Establish monitoring procedures

The CCP used for a specific food production must be monitored to determine, if the system is effective or not effective in control the hazards.

Principle 5 Establish corrective actions

The corrective actions must demonstrate that it is effective in controlling the potential hazards resulting from the deviation of CCP.

Principle 6 Establish verification procedures

Documents of CCP monitoring and any deviation and corrective procedures takes should be kept at the establishment.

Principle 7 Establish record keeping and documentation procedure

The approved HACCP plan and associated record must be file at the food establishment.

2.1.2 Application of HACCP principles.

Conduct a hazard analysis

The purpose of the hazard analysis is to develop a list of hazards which are of such significance that they are reasonably likely to cause injury or illness if not effectively controlled. The first, hazard identification, can be regarded the HACCP team reviews the ingredients used in the product, the activities conducted at each step in the process and the equipment used, the final product and its method of storage and distribution, and the intend use and consumers of the product. A list of potential biological or physical hazards which may be introduced, increased, or control at each step in the production process. Hazard identification focuses on developing a list of potential hazards associated with each process step under direct control of the food operation.

After the list of potential hazards is assembled, stage two, the hazard evaluation, is conducted. In stage two of the hazard analysis, the HACCP team decides which potential hazards must be addressed in the HACCP plan. During this stage, each potential hazard is evaluated based on the severity of the potential hazard and its likely occurrence. During the evaluation of each potential hazard, the food its method of preparation, transportation, storage and persons likely occurrence and severity of the hazard being controlled.

Determine critical control points (CCPs)

Complete and accurate identification of CCPs is fundamental to controlling food safety hazards. The information developed during the hazard analysis is essential for the HACCP team in identifying which steps in the process are CCPs. One strategy to facilitate the identification of each CCP is the use of a CCP decision tree (Figure 1)

Critical Control Points are located at any step where hazards can be either prevented, eliminated, or reduced to acceptable levels. Examples of CCPs may include: thermal processing, chilling, testing ingredient for chemical residues, product formulation control, and testing product for metal contaminants. They must be used only for purpose of product safety. For example, a specified heat process, at a given time and temperature designed to destroy a specific microbiological pathogen, could be a CCP.

Establish critical limits

This step involves establishing a criterion that must be met for each preventive measure associated with a CCP. Critical limits can be thought of as boundaries of safety for each CCP and may be set for preventive measure such as temperature, time, physical dimension, a_w, pH, and available chlorine.

Each CCP will have one or more preventive measure that must be properly controlled to ensure prevention, elimination, or reduction of hazards to acceptable levels. The food establishment is responsible for using competent authorities to validate that the critical limits chosen will control the identified hazard.

Establish monitoring procedures

Monitoring is a plan sequence of observations or measurements to assess whether a CCP is under control and to produce an accurate record for future use in verification. Monitoring serves three main purposes. First, monitoring is essential to food safety management in that it facilitates tracking of the operation. Second, monitoring is used to determine when there is loss of control and a deviation occurs at a CCP. Third, it provides written documentation for use in verification.

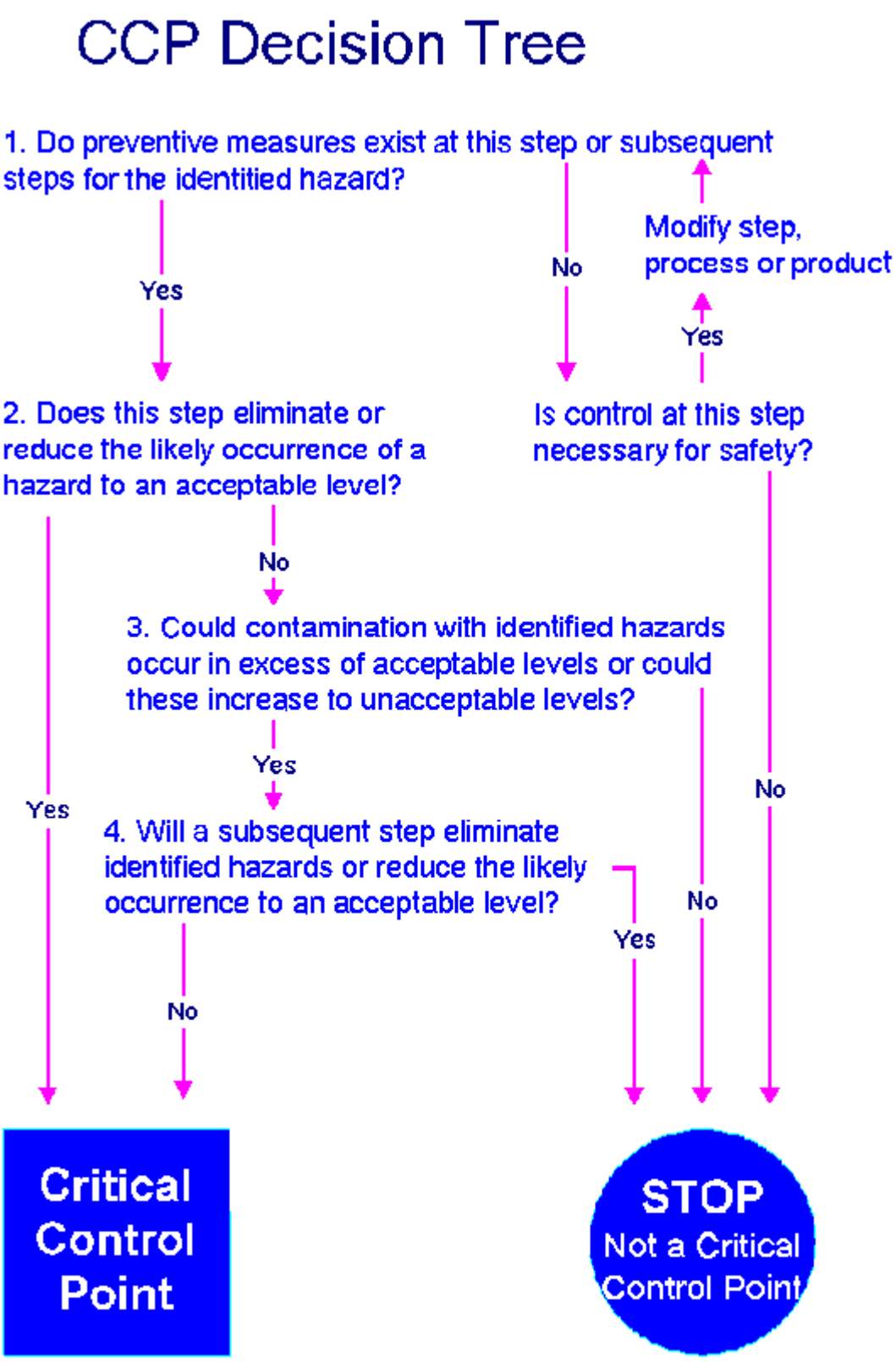


Figure 1 CCP Decision Tree

Most monitoring procedures need to be rapid because they relate to on-line, real time processes and there will not be time for lengthy analytical testing. Microbiological tests are seldom effective for monitoring due to their time-consuming mature and problems with assuring detection of contaminants. Physical and chemical measurements are often preferred because they are rapid and usually more effective for assuring control of microbiological hazards.

Establish corrective actions

An important purpose of corrective actions is to prevent foods which may be hazardous from reaching consumers. Where there is a deviation from established critical limits, corrective actions are necessary.

Establish verification procedures

Verification and auditing methods, procedures and tests, including random sampling and analysis, can be used to determine whether the HACCP system is working correctly. The frequency of verification should be sufficient to confirm the proper functioning of the HACCP system.

Initial verification of the HACCP plan is necessary to determine whether it is scientifically and technically sound, that all hazards have been identified, and that, if the HACCP plan is properly implemented, these hazards will be effectively controlled.

Establish record keeping and documentation procedures

Efficient and accurate documentation and record keeping are essential to the application of a HACCP system and should be appropriate to the nature and size of the operation.

2.2 Food-borne illness (13)

A food-borne illness is a general term applied to all types of illnesses caused by an organism, substance or material of any kind which is present in food and gains entrance into the body when such food is consumed.

Food-borne disease in particular gastro-intestinal infections, represent a very large group of pathologies with a strong negative impact on the health of the population (14).

The cause of contamination is generally faulty handling poor sanitary practices, insects, rodents or micro-organisms. The natural decay that occurs in animal or plant tissues is accompanied by foul odours, and changes in appearance and taste. As the spoilage is visible, people reject the food. The main cause for concern is food which is spoilt but where spoilage is not visibly noticeable. Such food is likely to be consumed and may result in disease.

2.3 Transmission of food (15)

Diseases may be transmitted by food by many following ways. These include:

- Even though the food itself may be wholesome, it may act as a vehicle of disease transmission. Pathogenic organisms can be moved from one person to another through a number of routes, for example: soiled linen, unclean cups, handkerchiefs, door handles etc. Illnesses like tuberculosis, typhoid and influenza may be also caused by food handled with soiled hands or on which an ill person or a carrier has coughed or sneezed. Moreover, the food may serve as an ideal medium for rapid growth and multiplication of micro- organisms like Staphylococci and Salmonella, resulting in food poisoning or food infection. These micro- organisms release toxins and therefore can cause violent illness of the stomach and intestinal tract. Although the bacteria may die, the toxins formed keep causing food poisoning. Some other bacteria cause an infection of the gastro-intestinal tract once they are consumed along with food.

- Food poisoning may be caused by agent other than micro-organisms, for example: toxic chemicals, poisonous plants like poisonous mushrooms, insecticides, pesticides, etc. Hence food borne hazards may result from microbial action, metals and pesticides, animal parasites, natural poisoning in foods or allergic reactions of person due to sensitivity to a particular food. Food transmi Disease is transmitted through either directly or indirectly. In direct transmission of disease, the following pathway is involved.

2.3.1 Direct Transmission

The food handler transmits pathogens to food. Because of coughing or sneezing on near the foods, droplets containing micro- organism may fall on the food. Furthermore, some disease of the intestinal tract may be transferred by unwashed or improperly washed hands. If food is handled by hands soiled with faecal matter,

disease-causing agents are transferred directly to the prepared food, causing illness after consumption. Openly displayed food can get contaminated by the customer handling it.

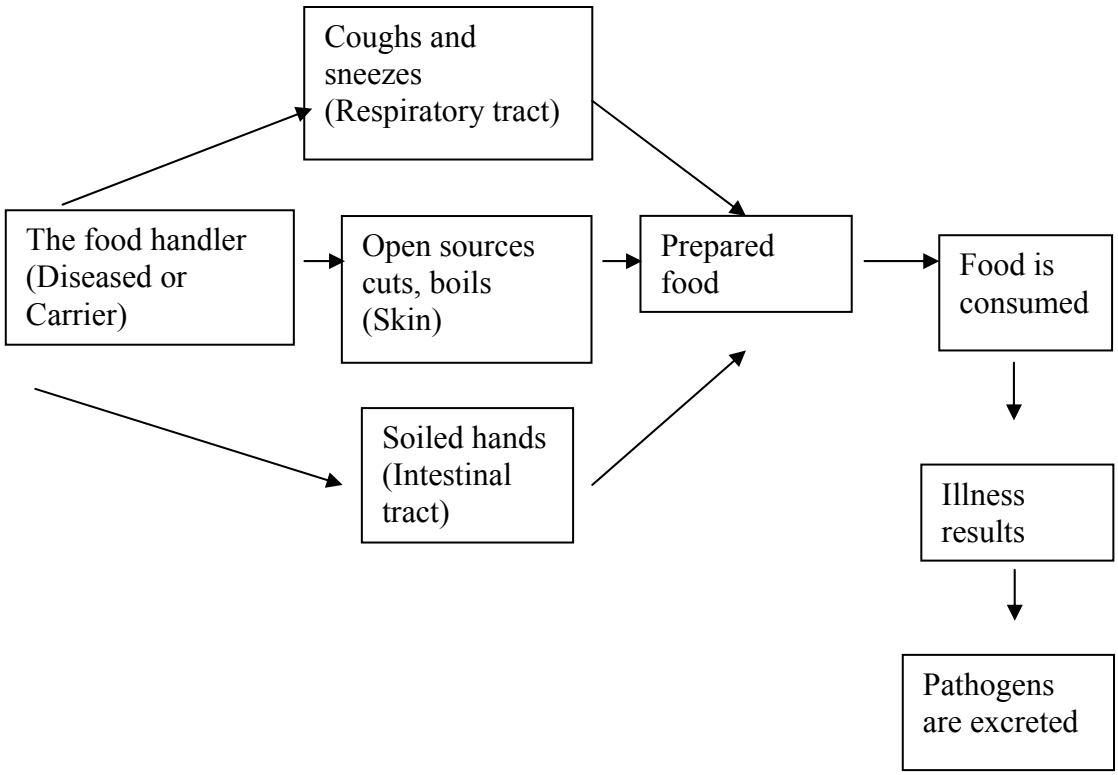


Figure 2 Direct Transmission

2.3.2 Indirect Transmission

Pathogens may be transmitted indirectly by the host of a communicable disease through various ways onto prepared food and from there to other people consumers. The other indirect routes of transmission of disease causing agents or pathogens include:

- contaminated utensils and equipment
- sewage polluted water and food grown on polluted soil or through faulty plumbing
- soiled linen, door handles and taps
- insects like flies and cockroaches

- rodents like rats and mice
- infected animals and their products

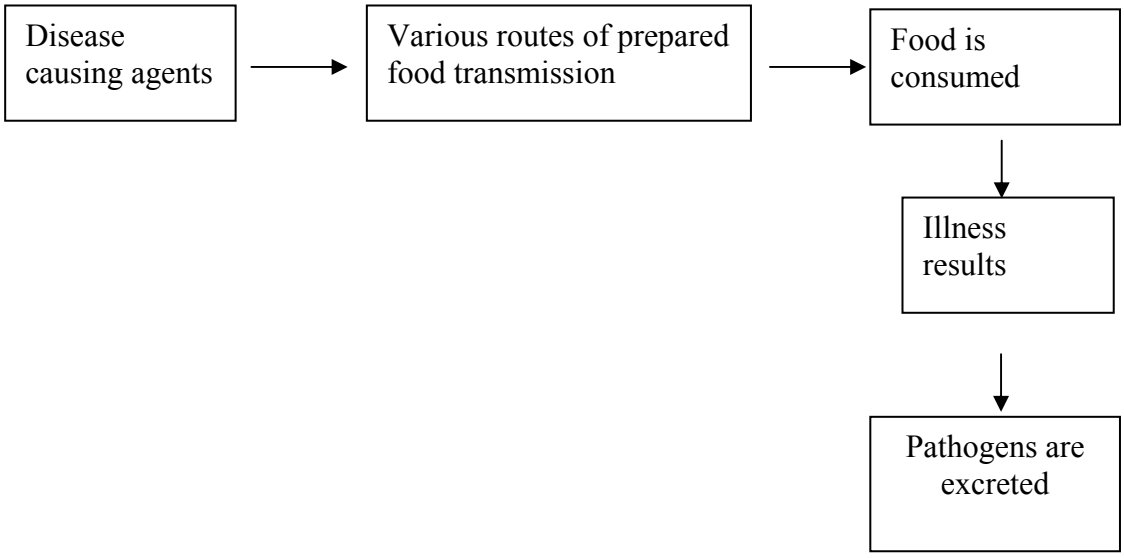


Figure 3 Indirect Transmission

Contamination of food may be caused through unclean utensils and equipment. The pathogenic organisms eliminated from the human body are to be found in sewage that is mainly faecal matter. Once untreated sewage drains into any drinking water, the water as well as fish breeding in such waters get contaminated. Salad vegetables, roots and tubers are at a greater risk of contamination as they are consumed raw and because they are in direct contact with the soil. Disease can be also transmitted by rats, mice, flies and cockroaches living in sewers and garbage dumps.

2.4 Food Poisoning (15,16)

Food poisoning or food intoxication is caused by toxins present in contaminated food. The toxin may be a poisonous chemical toxin which is accidentally or intentionally added, a naturally occurring poison like solanine in green or a toxic metabolite excreted by bacteria. In bacterial food poisoning, the toxin is produced during multiplication of cells. Once consumed, the toxin already present in food irritates the lining of the stomach and causes vomiting. Having reached the intestine, the toxin may cause abdominal pain and diarrhoea.

2.5 Food Infections

Food infection is caused by micro- organisms. Food infection results from the consumption of food containing living bacteria which are multiplying and capable of causing disease. Illnesses resulting is the reaction of the body to the presence of micro-organisms or to their metabolites. The gastric juices secreted in the stomach is acidic and destroys some bacteria. In the small intestine the pH is neutral and bacteria multiply rapidly. This irritates the lining of the intestines, resulting in nausea, diarrhoea and abdominal pains. The incubation period for an infection lasts on average 12 hours.

Approximately one million or more bacteria must be present in food allowing bacterial food poisoning or infection to occur. It is likely that food could be contaminated with several hundred causative bacteria. In favourable conditions for growth , these bacteria could multiply to over one million within three to four hour time span. The time lapse between the consumption of food and the appearance of symptoms is called the incubation time. The incubation time and the severity of the attack of bacterial poisoning or infection will depend on several factors, for example:

- The type of organism causing the illness - some types cause more kinds of illnesses than others.
- The susceptibility of the individual - this depends on the age of the person as well as his or her state of health. The very young and the old may suffer even after ingesting fewer bacteria.
- The number of bacteria or the amount of toxin consumed - the greater the number of bacteria and the greater the amount of toxin swallowed, the quicker and more severe is the attack.

Difference between Food Poisoning and Infection

Food Poisoning	Food Infection
Caused by toxin	Caused by living micro- organisms
Incubation period: two hours	Incubation period: 12-24 hours
Symptoms: nausea and vomiting	Symptoms: diarrhoea, abdominal pain,
Diarrhoea, usually no fever	vomiting, fever
Duration: one day, sometimes longer	Duration: one to seven days

2.6 Food contamination (13,15,16)

Food contamination results in spoilage, that can be broadly classified into six groups:

2.6.1 Microbiological action: Micro-organisms are present everywhere and can contaminate food and spoil it. Milk turns sour because of bacterial action, yeasts ferment fruit juices and mould grows on bread which has to be discarded. Some bacteria causing food poisoning or food infection may contaminate food handled unhygenically. In such cases, microbial growth may not be obvious. Not all micro-organisms can cause disease, in fact some are useful to the food industry.

2.6.2 Presence of contaminants: The food is said to be spoiled and should be rejected provided that any unwanted inedible matter is added to or is present in it. Contaminants present in food could be for instance nail chippings, hair, stones, grit, dirt or other extraneous matter.

2.6.3 Action of insects: Food may be spoiled because of the presence of worms, weevils, fruit flies, moths, etc. These may damage the food and reduce its nutrient content. Food spoilt by insects is not fit for human consumption. The presence of insects insect body fragments or droppings in food served to consumers is highly objectionable and will affect the reputation of the catering establishment.

2.6.4 Natural enzymes: Food spoilt by autolysis or the action of various enzymes naturally present in them. Signs of spoilage seen in fruits and vegetables include overmaturing, softening, browning and sprouting. After picking or harvesting, fruits and vegetables remain alive for sometime. They respire and ripen and if they are not consumed or processed soon they become over – ripe and ultimately spoil. Enzymes naturally present in meat act on mutton fibres and bring aboutautolysis. If these natural changes are not controlled, foods may spoil. As action of enzymes is influenced by temperature, refrigeration will retard the action and blanching will destroy the enzyme.

2.6.5 Physical changes: These kind of changes occur in food by freezing, desiccation, evaporation and absorption of moisture. Freezer burn is a physical change seen in deep frozen food. Mechanical damage during harvesting and transporting food, like brusing and crushing of fruits and vegetables, broken eggs and cracked shells, can accelerate spoilage by micro-organisms because of easy access. It also results in

greater susceptibility to decay and discoliuration by enzyme action. A way to prevent from it, is a proper storage and transport facilities.

2.6.7 Chemical reactions: Chemical spoilage of food may result from chemical changes, which are not catalyzed by natural enzyme or action of micro-organisms. A reaction between acidic food and iron from the can causes hydrogen swell in canned food. Development of oxidative rancidity in fat and the fatty phases of foods results in spoilage of fried snacks and oil-based pickles. Other changes include oxidation discolouration, flavour changes and nutritive loss. Spoilt food can cause a great financial loss to the catering establishment. Spoilt food is best discarded. However, bacteria causing food poisoning may spoil the food without showing any visible signs of spoilage. Thus the caterer should take care to prevent spoilage from occurring. Once a food is spoilt, no cooking, freezing or proper handling can make it appropriate for consumption.

2.7 Factor Affecting Growth of Microbes (15,16,17,18,19)

A number of different environmental conditions influence the growth and multiplication of microbes. The key factors, which have an influence on growth include:

2.7.1 Food and nutrients: The microbial flora present on food depends to a great extent upon its composition. Food serves as a substrate for microbes that use our food supply as a source of nutrients for their growth. Micro- organisms require food for energy and growth. They need carbohydrates and proteins as a source of carbon and nitrogen respectively. Some micro- organisms can synthesise a few or all of the vitamins needed, others depend on food for them. Along with vitamins, trace elements are also required.

2.7.2 pH level: Most bacteria prefer a neutral pH between 6.5 to 7.5, but some can grow at a low or high pH. Moulds and yeast grow better in an acidic medium of pH 4 to 4.5 as compared to bacteria. In general, with an acidic pH have a better keeping quality, like curds, pickles, fruits, etc.

2.7.3 Moisture: Since water accounts for a large percentage of the weight of the cell, it is necessary for growth of all micro- organisms. Water or moist conditions encourage the growth of most micro- organisms. Therefore, storing food in well-

ventilated, dry and cool storage areas and not in a humid kitchen should prevent it from spoilage.

2.7.4 Temperature: Extreme temperatures have a significant influence on microbial growth. At high temperature (above 65^0C), micro- organisms are destroyed and at low temperatures, their growth is retarded (below 5^0C).

Each organism has an optimum temperature at which it grows best as well as a minimum temperature below which it cannot grow and a maximum temperature above which it cannot grow. Organisms having an optimum temperature below 20^0C, for example Pseudomonas, are called psychrophilic organisms. They grow at refrigeration temperature and some grow on frozen foods. The mould Penicillium also grows at low temperatures. Mesophilic organisms have an optimum temperature between 20^0C and 45^0C. Most bacteria, specially human pathogens belong to this group. Thermophilic organisms, for example, the spore-forming micro-organisms like Clostridium and Bacillus, have an optimum temperature above 45^0C.

2.7.5 Oxygen: Oxygen has proved to be necessary for all aerobic micro-organisms. Anaerobic micro- organisms do not require it and it may even be toxic to certain anaerobic micro-organisms. Moulds and most yeast grow best in the presence of oxygen, while bacteria may be aerobic, anaerobic or facultative. Pathogens may grow better in inadequately ventilated than in airy areas.

2.7.6 Time: Micro-organisms given a favourable environment in terms of temperature, moisture and nourishment multiply rapidly and in a short span of time they would have multiplied to numbers large enough to cause harm. Food often contains small numbers of pathogenic micro- organisms, which multiply rapidly and can cause food borne illness. Food consumed as soon as it cooked, is less likely to cause harmful poisoning.

2.7.7 Osmotic pressure: The osmotic pressure of food differs with the kind and amount of solute dissolved in food. The amount of sugar or salt in solution has an osmotic effect on micro-organisms. This is because of the semipermeable nature of the cell. If a bacterial cell is kept in a hypotonic solution (a solution having an osmotic pressure lower than that of the bacterial cell), water from the surrounding media will enter the cell resulting in swelling. If the difference in osmotic pressure is still more, the cell bursts. This phenomenon is known as plasmolysis. If the bacterial cell is kept

in a hypertonic solution (a solution having an osmotic pressure higher than that of the bacterial cell), water from the interior of the cell goes into the surrounding medium resulting in the shrinkage of the cell. This phenomenon is called plasmolysis.

2.7.8 Sunlight or ultraviolet rays: Dark humid places contrary to well lit and naturally ventilated places encourage microbial growth. This is due to ultraviolet rays that destroy microbes are present in sunlight. They are used to purify air in food storage areas and for surface sterilisation of certain kinds of food like meat or cheese.

2.8 Microbiological Hazards (20,21,22,23,24,25)

2.8.1 Yeasts and Molds

Both yeasts and molds cause various degrees of deterioration of foods. They can invade and grow on virtually any type of food at any time. They also grow on processed foods and food mixtures. The ability of this organisms to attack many foods is due in large part to their relatively versatile environmental requirements. The acid/alkaline requirement for growth is ranging from pH 2 to above pH 9. Their temperature range (10-35^{o}c) is able broad. Moisture requirements of foodborne molds are relatively low; most species can grow at water activity (a_w) of 0.85 or less although yeasts generally require a higher water activity.

Several foodborne molds, and possibly yeasts, may also be hazardous to human or animal health because of their ability to produce toxic metabolites known as mycotoxins. Most mycotoxins are stable compounds that are not destroyed during food processing or home cooking. Even though the generating organisms may not survive food preparation, the performed toxin may still be present. Certain foodborne molds and yeasts may also elicit allergic reactions or may cause infections. Although most foodborne fungi are mot infectious, some species can cause infection, especially in immunocompromised populations, such as the aged and debilitated, HIV-infected individuals, and persons receiving chemotherapy or antibiotic treatment.

2.8.2 Coliform bacteria

Coliform bacteria was coined to describe the group of enteric bacteria. Coliform is not a taxonomic classification but rather a working definition used to

describe a group of Gram- negative, facultative anaerobic rod-shaped bacteria that ferments lactose to produce acid and gas within 48 h at 35^0C.

Detection of coliforms is used as an indicator of sanitary quality of water or a general indicator of sanitary condition in the food-processing environment.

2.8.3 *Escherichia coli*

Escherichia coli is widely distributed in the intestine of humans and warm-blooded animals and is the predominant facultative anaerobe in the bowel and part of the essential intestinal flora that maintains the physiology of the healthy host. *E.coli* is a member of the family *Enterobacteriaceae*, which include many genera, including known pathogens. Although most strains of *E.coli* are not regarded as pathogens, they can be opportunistic pathogens that cause infections in immunocompromised hosts. There are also pathogenic strains of *E.coli* that when ingested, causes gastrointestinal illness in healthy humans. *E.coli* is used as an indicator of fecal contamination. This was based on the premise that *E.coli* is abundant in human and animal feces and not usually found in other niches. Furthermore, since *E.coli* could be easily detected by its ability to ferment glucose (later changed to lactose), it was easier to isolate than known gastrointestinal pathogens. Hence, the presence of *E.coli* in food or water became accepted as indicative of recent of fecal contamination.

There are at least four subgroups of enteropathogenic *Escherichia.coli*: enterotoxigenic, enterivasive, hemorrhagic, and enteropathogenic. Each strain has different characteristics. The major source of the bacteria in the environment is probably the feces of infected humans, but there may also be animal reservoirs. Feces and untreated water are the most likely sources for contamination of food.

2.8.4 *Salmonella spp*.

This is the commonest cause of bacterial food borne disease and the most serious. Organisms of the salmonella group cause an infection in the intestine. Many species are infections. These rod-shaped bacteria are aerobic and non-spore producing. They are present in the intestine of humans and animals and are excreted in the faeces. Illness occurs when living organisms are ingested in large numbers. If a small number of organisms are allowed to multiply in food then infection can result.

Salmonella is a rod-shaped, motile bacterium-nonmotile exceptions *S.gallinarum* and *S. pullorum*-, nonsporeforming and gram-negative. *S. typhi* and the paratyphoid bacteria are normally caused septicemic and producte tyohoid or typhoid-like fever in humans. Other forms of salmonellosis generally produce milder symtoms .

The gastrointestinal tracts of animals and man are common sources of Salmonella. High protein foods such as meat, poultry, fish and eggs are most commonly associated with Salmonella. However, any food that becomes contaminated and is then held at improper temperatures can cause salmonellosis. The major causes of salmonellosis are contamination of cooked foods and insufficient cooking.Contamination of cooked foods occurs from contact with surfaces or utensils that were not properly washed after use with raw products.

2.8.5 Staphylococcus aureus

Staphylococcus aureus is a spherical bacterium (coccus) which on microscopic examination appears in pairs, short chains, or bunched, grape-like clusters. These organisms are gram positive. Some strains are capable of producing a highly heat-stable protein toxin that causes illness in humans (18). Skin and superficial wounds are common sources of *Staphylococcus aureus*. When *Staphylococcus aureus* is allowed to grow in foods, it can produce a toxin that causes illness. Although cooking destroys the bacteria, the toxin produced is heat stable and may not be destroyed.

This bacteria is widespread and is frequently found in the throat and nose of 30 percent of all healthy people and in the nasal discharges of persons recovering from cold. On the skin, it is present in pimples, boils and infected wounds. Droplets from the nose or throat sneezed or coughed into the air could contaminate air, clothing, handkerchiefs and skin. Hands could be contaminated by soiled handkerchiefs or tissues or by touching the nose or any eruptions on skin, and could get heavily contaminated with these micro organisms. If hand are not washed and scrubbed well, contamination is transferred to food, utensils or equipment during food preparation. Hence, the need for food service personnel to follow proper sanitary procedures in food preparation and practice correct hand habits.

Food that are frequently incriminated in staphylococcal food poisoning include meat and meat products; poultry and egg products; salads as egg, tuna, chicken, potato, and macaroni; bakery products such as cream-filled pastries, cream pies, and chocolate eclairs; sandwich fillings; and dairy products. Foods that require considerable handling during preparation and that are kept at slightly elevated temperatures after preparation are frequently involved in staphylococcal food poisoning.

2.8.6 *Clostridium perfringens*

Clostridium perfringens is an anaerobic, gram positive, sporeforming rod. It is widely distributed in the environment and frequently occurs in the intestines of humans and many domestic and feral animals. Spores of the organism persist in soil, sediments, and areas subject to human or animal fecal pollution.

When food containing a large number of *Clostridium. perfringens* is consumed, the bacteria produce a toxin in the intestinal tract that causes illness. *Clostridium. perfringens* can exist as a heat resistant spore, so it may survive cooking and grow to a large numbers if the cooked food is held between 40 degrees F and 140 degree F for an extensive time period.

Clostridium perfringens transmits from human faeces via hands to the food by direct contact, vector transmission by flies sitting on excreta, cross contamination from raw to cooked meat, dusty kitchens and dirty cardboard boxes placed on work tables. In raw meat from intestines and excreta.

2.8.7 *Vibrio cholerae*

Vibrio cholerae serovar O group 1 is responsible for epidermic or Asiatic cholerae. Cholera is an extremely derious worldwide, usually water-borne disease. A limited number of outbreaks in the continental United States have been identified as being transmitted by seafood. Other serovars, non 01, do not represent the same health threat as does *Vibrio cholerae* 01 but can be responsible for intestinal infection or gastroenteritis. These *Vibrio cholerae* strains, which closely resemble 01, are referred to as nonagglutinable (NAG) vibrios because they do not react or agglutinate in the anti-01 serum. Several surveys conducted in the Chesapeake Bay and along the Gulf States suggest that both 01 and non 01 *Vibrio cholerae* are fairly

common in estuary water. Food borne outbreaks of *Vibrio cholerae* and non-01 strains have been associated withed the consumption of oysters.

Vibrio cholerae transmitted by direct contact with hands and clothing soiled with the excreta of a diseased person, ingestion of polluted and contaminated water, food and aerated water, contaminated equipment and vector transmission by houseflies.

2.9 Microbiological safety of fresh fruits and vegetables (26,27)

2.9.1 At the grocery store

Do not buy product that is badly bruised, cut, or shows signs of insect bites unless you use it immediately. These conditions create openings that allow microorganisms and enzymes to spoil the product more quickly.

2.9.2 In storage

Cold temperature slow the rate of spoilage and the growth of harmful microorganisms. Cutting and peeling can increase the number of microorganisms, so store all cut produce in the refrigerator. Store produce above meat, fish, and poultry so their juices do not drip onto the produce and make it unsafe to eat.

2.9.3 During preparation

If you plan to eat fruits or vegetables raw, wash them first. Washing will remove some of the microorganisms on the surface. Wash them even if you do not eat the rind or skin. When you cut into produce, microorganisms that are on the surface can be transferred to the inner flesh.

Bacteria can be spread throughout the kitchen and get onto cutting boards, utensils, and countertops. When cutting fruits and vegetables, always use a clean knife and clean cutting surface. Never use utensils or surfaces that have been in contact with other foods, especially raw meat, fish, or poultry, without properly cleaning them first, Raw meat, fish, and poultry contain bacteria that could contaminate raw fruits and vegetables.

Fruits and vegetables carry a natural flora, which ordinarily does not include types pathogenic to man. The organisms causing spoilage in fresh and stored foods are not pathogenic to man either; for information on microbial spoilage of fresh and refrigerated pant foods.

Plants may acquire human pathogens from contact with contaminated soil, water, human hands, animals, air, harvesting equipment, and so forth. The nature of the contamination depends on many factors. An important source of contamination is soil containing raw sewage.

Fresh fruit may become contaminated from soil dust in the orchard. Fruit collected from the ground, and low-growing fruit, often becomes heavily contaminated with soil organisms. Dust from the road may be an important source when fruit is displayed on road stands. One of the important sources from public health point of view is human hands. During harvesting, subsequent sorting, and storing, fruit may acquire the flora adhering to the handlers' hands. Certain species of molds have been shown to be able to penetrate the skin of certain fruit and produce mycotoxins in the fruit.

2.10 Food hygiene (28).

Food hygiene may be defined as the sanitary science which aims to produce food which is safe for the consumer and of good keeping quality. Some of the means by which foodstuffs can be protected from gross contamination will be obvious, but others may not be quite so clear. The immediate application of methods to raise standards of hygiene are sometimes thought to be impracticable, yet they should be discussed in the light of plans for future establishments designed for the preparation and service of food and for the training of food handlers.

There are two salient features which are important.

1. The separation of raw and cooked foods in the general work flow of the large kitchen; this includes the necessity for different areas, workers, equipment, and utensils for raw ingredients and for the cooked products. Food handlers in small kitchens can only take note of the necessity for care in cleansing hands, equipment, and utensils in between work with raw and cooked foods, This injunction is necessary for shops also.

2. The care of foods after cooking by almost any method; it is essential to cool quickly and refrigerate all foods which are not to be eaten hot and freshly cooked

If these two measures alone were understood and taken into earnest consideration there would be little food poisoning today. Other points which are better known may be listed as follows:

1. Care of the hands by washing is usually applied to measure but hands should be washed carefully between work jobs and after touching raw foods.

2. Care not to touch cooked foods with the bare hands because the washing of hands cannot be an assurance against the removal of staphylococci.

3. The removal from work with susceptible foods of any worker with septic lesions anywhere o the body. Clean, non suppurative abrasions should be cover with a waterproof dressing.

4. The elimination of flies, rats, mice and other pests from food establishments.

5. Careful instructions for cleaning the environment, equipment, food and drink containers and utensils. Recommendations for good detergents, for cleaning and for boiling and very hot water for disinfection; chemical disinfectants may be necessary in some instances. The substitution of disposable paper for cloths, which otherwise should be boiled daily along with mop heads used for cleaning.

6. Cleanliness of all the surfaces and equipment used for cooked foods.

7. Rapid cooling and cold storage of foods not intended to be eaten immediately on arrival or after cooking.

2.11 Salads

Salads are mixtures of minimally processed read-to-eat vegetables. Other common ingredients are fruits, poultry, meat, seafood, egg, nuts and cooked vegetables. Salads may be served with or without dressing depending on consumers' preference. Some types of salads consist of ingredients mixed with dressings. Other types of salads, or in case of pre-packaged salads, may contain ingredients only and separate package of dressing is available for consumers to mix with the ingredients by themselves (23).

Salad dressing have many types such as mayonnaise. Mayonnaise is a smooth creamy, semi-solid emulsified dressing, often used as a base for other dressings (22).

2.10.1 Flow chart of salads production (23).

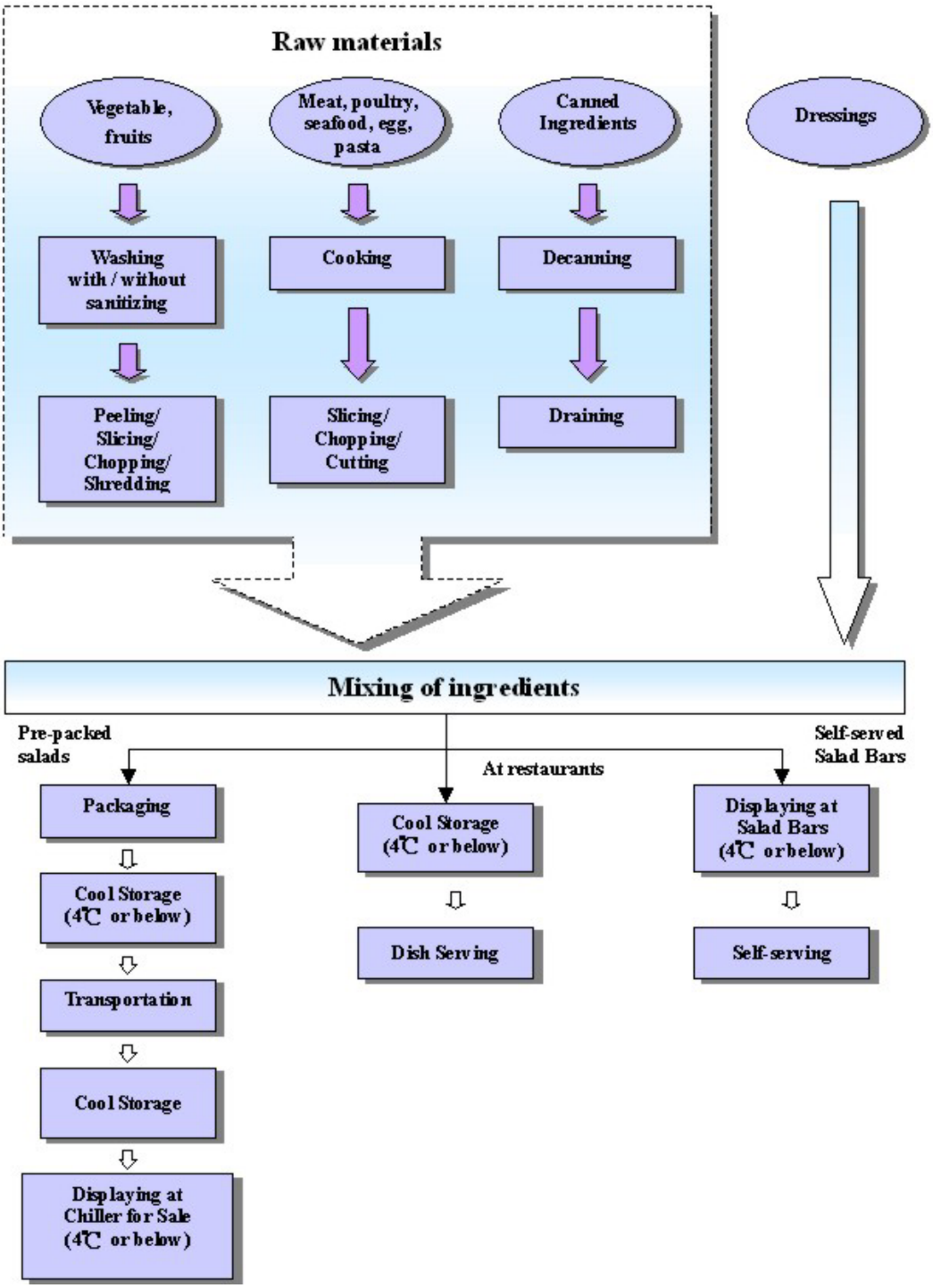


Figure 4 Flow chart of salads production

2.11 Related Research

K Pellicer *et.al* studied about analysis health and safety condition of ready-to-eat salads bought in market in La Plata found 88% fecal coliform bacteria, 64% *Escherichia coli*. This studied conclude that 88% of fresh cut salad did not meet the health and safety conditions required for human consumption. This studied suggested that increasing attention to sanitation, hygiene and application of Hazard Analysis and Critical Control Point (HACCP) procedures during manufacturing practice should help to reduce the risk of health to eat salads (1).

Vanessa L Bornemeier *et.al* surveyed the safety of mayonnaise-based salads available in grocery store delis for potential contamination with *Staphylococcus aureus* and *Listeria monocytogenes*. Three mayonnaise-based salads (potato, macaroni, and Krab) purchased from three grocery store deli operations in Lincoln, Nebraska. Results of this survey indicated that temperature conditions for all three salads and the pH range for Krab salads could support growth of pathogenic microorganisms. Food handling and storage practices indicated that HACCP procedures are necessary to ensure the safety of salads bar operations (4).

Food and Environmental Hygiene Department studied about the microbiological risk assessment on salads in Hong Kong. They showed that improper handling of ingredients and contamination after processing are the two main pathways to contaminate the final products. Both the trade and consumers are advised to take necessary precautions to enhance food safety in preparation and consumption of salads (23).

P Jongkitcharoen (1997) studied vegetable salad from the supermarket which started from raw materials, food preparation and handling food processing, distribution system and consumer handling. The study had analysed *E. coli,* Salmonella, *S. aureus* from samples of vegetable salad, swab of food handler and swab of utensil and equipment. From the study found CCPs in step of rinsing vegetable, step of slicing and chop & locks, utensil use in the process, food handlers' hand and temperature of keeping (29).

CHAPTER III
MATERIALS AND METHODS

3.1 Research design

The descriptive survey and participatory observation was designed to analyze the microbiological hazards and to determine the Critical Control Point of salads production. The food sellers were selected by purposive sampling from street vendor and salad bar in supermarket. There were 2 stages of studying in each place which were hazard analysis and determination of Critical Control Point. The hazard analysis consisted of 2 stages; participatory observation and microbiological analysis. The salad preparation and displaying practices were observed to identify sources and mode of contamination. Then, salad ingredients and mayonnaise dressing were collected to analyze for microbiological hazards.The microbiological hazards were expressed in terms of coliform bacteria, *Escherichia.coli*, *Staphylococcus aureus*, *Salmonella spp., Clostridium perfringens* , *Vibrio cholerae*, yeast and mold . The microbiological result was compared with the microbiological standard of the Department of Medical Science .The Critical Control Point at steps of preparation and displaying of salad were determined by using the decision tree recommended by World Health Organization (WHO).

3.2 Sampling site

Samples for analysis were collected from street vendor in the area nearby the victory monument and salad bar in supermarket.

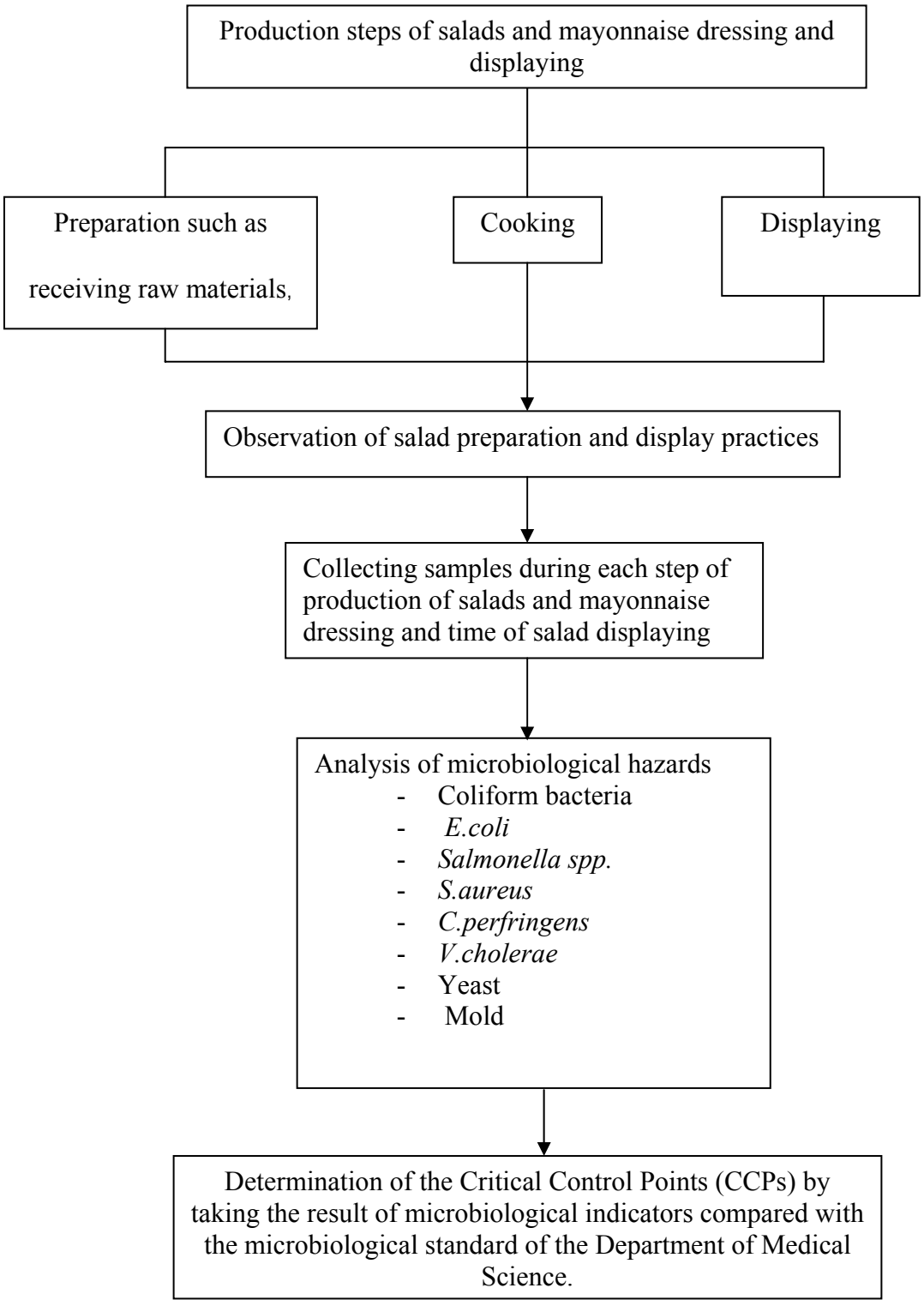
3.3 The place of experiment

All samples were analyzed at the Health Laboratory Division, Health Department, Bangkok Metropolitan Administration.

3.4 Population

The populations of this study were 35 kinds of salad ingredients ; 12 ingredients form salad sold by street vendor, 23 ingredients form salad bar in supermarket and 7 kinds of mayonnaise ingredients.

3.5 Experimental Procedure



3.6 Research instrument and equipment (20,30)

3.6.1 Research instrument

- Sterile petri dishes
- Tubes and Durham tubes
- Autoclave
- Sterile pipettes 10, 1, 0.1 ml.
- Sterile cotton
- Sterile stomacher bags
- Stomacher
- Alcohol lamp
- Slide and cover slip
- Loop
- Incubator at 35±1^{o}c and 42±2^{o}c
- Water bath at 45.5±0.2^{o}c
- Hotplate / stirrer
- Balance meter
- Beakers
- Stirring rods
- Distilled water
- Refrigerator
- pH meter
- Sterile, bent-glass streaking rods
- Vortex mixer
- Sterile needles
- Sterile stainless spoons, forceps, scissors
- Container of ice
- Colony counter
- Anaerobic jars
- BBL Gas Pak
- Arnold steam chest

3.6.2 Reagents and culture media

Yeasts and Molds

- Dichloran rose bengal chloramphenical (DRBC) agar
- Dichloram 18% glyceral agar
- Plate count agar
- Malt agar
- Malt extract agar
- Potato dextrose agar

Coliform and *Escherichia coli*

- Lauryl Sulfate Tryptose Broth
- Brillaint Green Lactose 2%Bile Broth
- EC broth
- 1%Tryptone Broth
- Triple Sugar Iron Agar
- Kovac's Reagent
- Citrate Test
- Eosine Methylene Blue (EMB agar)

Staphylococcus aureus

- 10%Salted Trypticase Soy Broth
- Manitol Salted Egg Yolk Agar (MSEY)
- Brain Heart Infusion Broth
- Rabbit plasma

Salmonella spp.

- Buffer Peptone Water
- Modify Semisolid Rappaport Vasellaadis
- SS Agar
- Triple Sugar Iron Agar
- Lysine Indole Motile
- Salmonella Antisera Polyvalent (A-I, A-67)
- Salmonella Antisera Group A, B, C, D and E

Clostridium perfringens

- Cooked Meat Medium
- CW-EY agar
- Lactose Gelatin Medium
- Motility Nitrate Medium
- Reagent A (Sulfunalic Acid Reagent)
- Reagent B (N-1-Naphthyl ethylenediamine dihydrochloride)
- Powder Zinc Metal

Vibrio cholerae

- 0.5 % NaCl Alkali Peptone Water
- Thiosulfate Citrate Bile Salt Sucrose Agar
- Triple Sugar Iron Agar (TSI)
- Lysine Indole Motile (LIM)
- Carbohydrate Fermentation
- Polyvalent Antisera O -1

Total plate count

- Phosphate buffer pH 7.2
- Plate count agar

3.7 Experiment method (20,30,31,32)

3.7.1 Hazard analysis

- This study observed food preparation and display practices to identify source and mode of contamination.

- The samples were collected to identify by using aseptic technique

- Each ingredient of salad and mayonnaise approximately 200 g were randomly collected during each step of preparation , first displaying and after 2 hrs of display but not more than 3 hrs in order to determine the contamination of microbiological hazards.

- Utensils and food contact surface were swabbed at each step of preparation by using sterile techniques.

3.7.2 Determination of the Critical Control Point (CCP)

The Critical Control Point was determined by comparison of microbiological indicators, comparing with the microbiological standard of the Department of Medical Science and using decision tree recommended by World Health Organization (WHO).

3.7.3 Examination of microbiological hazards in food samples

Microbiological hazards	Testing Procedure
Total plate count Yeasts and Molds Coliform and *Escherichia coli* *Staphylococcus aureus* *Salmonella spp*. *Clostridium perfringens* *Vibrio cholerae*	Modified from FDA, Bacteriological Analytical Manual (see Appendix B)

Table 1 Examination of microbiological hazards in food samples

3.8 Data analysis

- The microbiological hazards were compared with the standard of the Department of Medical Science by using descriptive statistics

- The Critical Control Point was determined at each step of salad production by using microbiological indicators and decision tree.

CHAPTER IV
RESULT

4.1 Observing food preparation and displaying practice

4.1.1 Salad sold by a street vendor

Preparation place

The salad ingredients were prepared in kitchen and a part of balcony of their living place located in Din Dang District. Cleaning and boiling of salad ingredients were done at the balcony, while fresh ingredients were prepared in the kitchen. The working area is shown in Figure 5

Preparation steps

Raw materials of salad were bought from 2 places, which were Klong toey fresh market and Rang sit wholesale market. The preparation of salad started at around 11.00 am to 1 p.m.

There were 2 groups of salad ingredients; boiled and fresh ingredient. The boiled ingredients which were initially prepared, were red kidney bean fresh corn ingredients sweet potato, barley and eggs. The fresh were then prepared starting from peeling, cleaning shredding, slicing and cutting. All Preparation steps were preformed on the kitchen floor and continued during displaying when some ingredients were shortage.

Next, mayonnaise dressing which was composed of vinegar, lemon, oil, yolk egg, salt, sugar and mustard, was prepared by using modified instrument. The dressing would be used for 2 days after preparation

Personal hygiene

The street vendors have just only washed their hands without soap before started to work. They did not wear any apron or hair cover while preparing salad.

Utensil

Utensil and equipment which were used to prepare salad were knife, chopping block, tray, a two edged knife, plastic bowl, tongs and ladle. They were kept in a clean place.

Displaying

The finished ingredients were brought to display and sell at the stall in front of public toilet nearby the Victory Monument and the Fashion Mall Department Store from 5.00 p.m. to 9.00 p.m. The ingredients were put in separate plastic bowl at ambient temperature without any prevention of contamination from the surrounding environment. The salad then were sold and packaged according to the consumers' requirement.

4.1.2 Salad bar in Supermarket

Preparation Place

The supermarket selected for the observation was located near the Victory Monument. Working area was a small room with many people working at the same time. The staff was responsible not only preparing salad ingredients but also other products, for example pork fish and seafood. In the preparation room there were 2 big refrigerators; one for storage of fruit and vegetables and the other for storage of pork, fish and seafood. There were also 2 sinks for washing hand and raw material. A detailed of preparation room is shown in Figure 6

Preparation steps

Salad ingredients were prepared by an employee who worked in fruit and vegetable department, starting at 6.00 am everyday. There were 3 main groups of salad ingredients, which were fresh, boiled and canned ingredients. The ingredients for coleslaw and potato salad were prepared at a later stage. Both fresh and boiled ingredients, fruit and vegetables were from supermarket. In contrast canned ingredients were ordered from supplier.

The Preparation steps started with preparing canned ingredients. Firstly, the personnel took the ingredients out of cans and put in stainless trays. Then each fresh ingredients were prepared separately, starting from cleaning, peeling, cutting, slicing and shedding, respectively. After that the boiled ingredients were prepared in

the same steps as the fresh, but boiling step was added. Finally, Coleslaw and potato salad were prepared.

Around 1.00 pm the staff prepared some of the salad ingredients that were kept overnight in refrigerator for the next day. These include carrot, red cabbage, potatoes and fresh mixed vegetable.

Personal practice

Salad ingredients were prepared by an employee who worked in fruit and vegetable department. The personnel wore uniform, apron and hair cover. Hands were always washed before the whole process starts.

Utensils

Utensils were always kept in a clean place and knives were sealed with plastic.

Displaying

After finished preparing, each salad ingredients was brought to displaying stall immediately. The temperature at the displaying stall was approximately 12^{o}c.

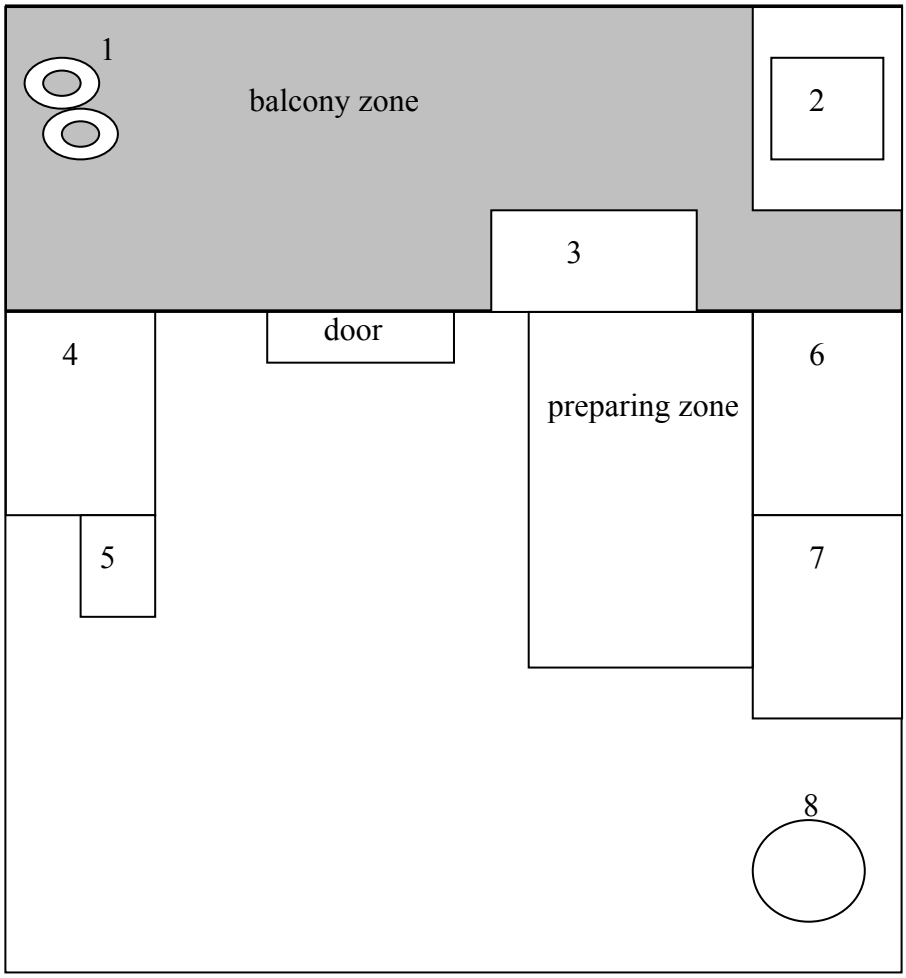


Figure 5 Layout of street vendor salad's working area.

1 – gas stove

2 – sink

3 – shelf

4 – toilet

5 – refrigerator

6 – table

7 – cupboard

8 – modified instrument for preparing mayonnaise

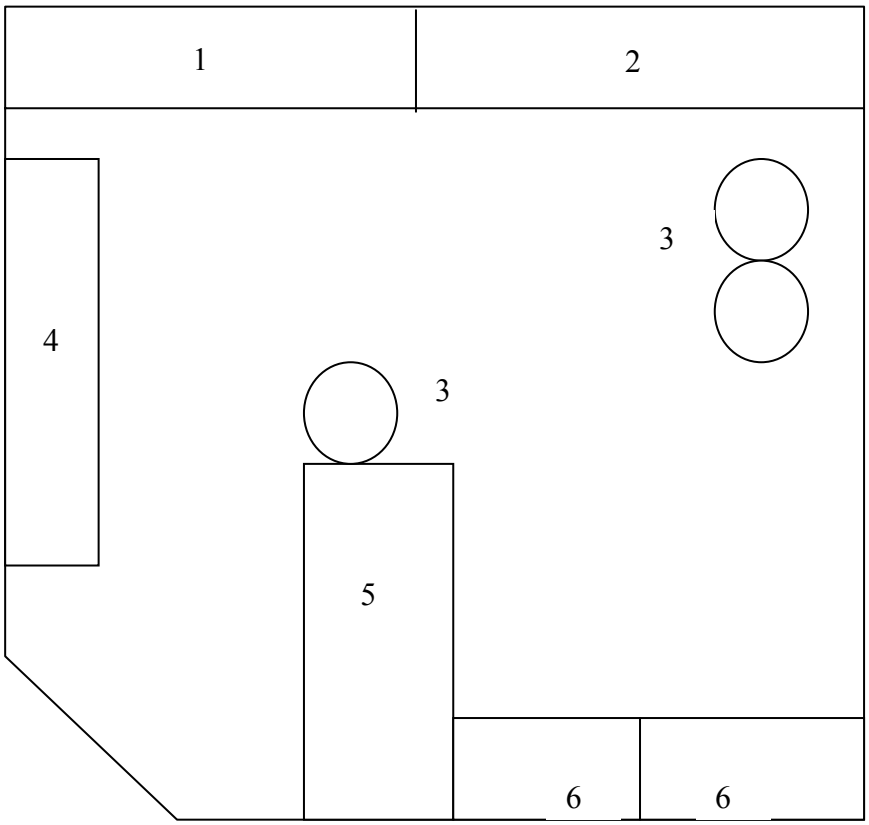


Figure 6 Layout of supermarket's working area.

1 - refrigerator for vegetables

2 - refrigerator for seafood, pork and meat

3 - bins

4 - counter for preparing fresh and miscellaneous ingredients

5 - counter for preparing boiled ingredients

6 - sinks

4.2 Microbiological quality of salad sold by street vendor and salad bar in supermarket

The results of 8 microbiological examination of salads ingredients were divided into two groups: microbiological indicators and pathogenic organisms. In this chapter showed only the number of microbiological indicators: coliform bacteria, *E.coli*, yeast and mold. The result of pathogenic organisms was shown in Appendix D.

4.2.1 Microbiological Quality of salad sold by street vendor.

Salads sold by street vendor were determined from three main groups of salad ingredients which were fresh ingredients, boiled ingredients and mayonnaise dressing.

Cucumber

Table 2 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of cucumber preparation.

Process (step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	1,100.0	1,100.0	290.0	<3	3.6	<3	250	$2.0x10^4$	$5.0x10^4$	<10	<10	<10
2	<3	20.0	14.0	<3	<3	<3	20	150	20	<10	<10	<10
3	<3	<3	<3	<3	<3	<3	20	20	<10	<10	<10	<10
4	<3	<3	<3	<3	<3	<3	10	20	20	<10	<10	<10
5	3.6	3.0	12.0	<3	<3	<3	130	150	40	<10	<10	<10
6	15.0	210.0	290.0	<3	<3	<3	650	250	150	<10	<10	<10

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→ Peeling→ cleaning → slicing → displaying → after displaying 2 hrs

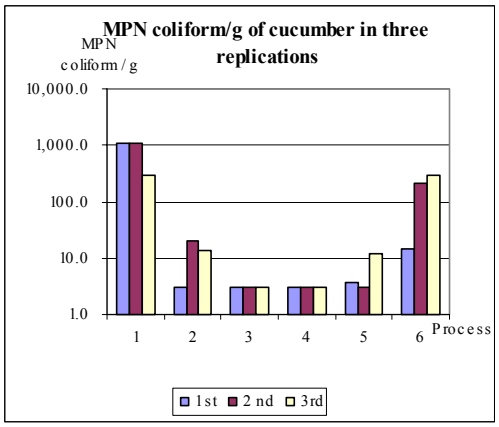

Figure 7 MPN coliform /g with three replications in each step of cucumber preparation.

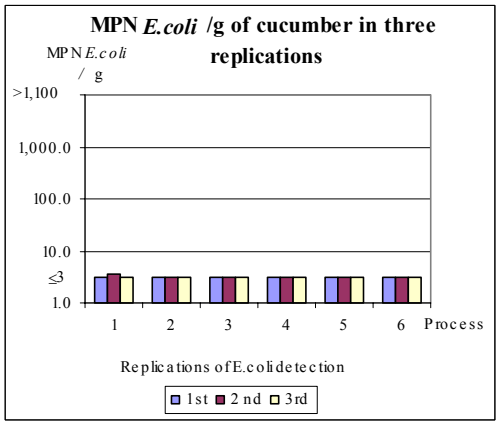

Figure 8 MPN *E.coli* /g with three replications in each step of cucumber preparation

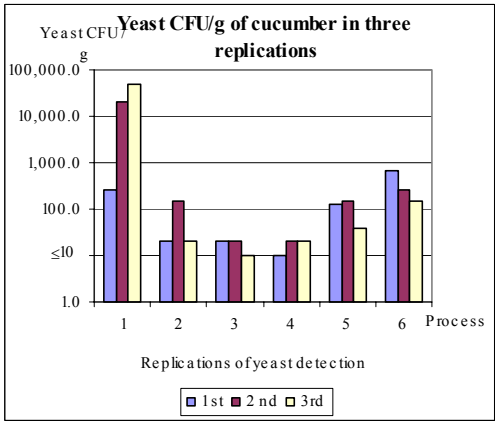

Figure 9 Yeast, CFU /g with three replications in each step of cucumber preparation.

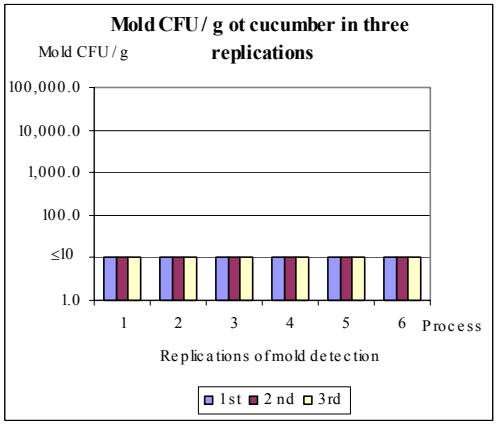

Figure 10 Mold, CFU /g with three replications in each step of cucumber preparation

The data in table 2 were presented by types of microbiological indicators in cucumber and also shown in Figure 7, 8, 9 and 10.

Preparation steps

Figure 7 showed the number of MPN coliform /g in three replications. In the first replication, it was 1,100 in step 1 and then decreased rapidly to less than 3 in step 2, 3 and 4. In the second replication, it was 1,100 in step 1 with the same number as in the first replication and after that decreased sharply to 20 in step 2. It still decreased to

less than 3 in both step 3 and 4. For the third replication, it was 290 in step 1 then decreased sharply to 14 in step 2. It continued decreasing to less than 3 in both step 3 and 4, whereas in step 5 it increased slightly to 12.

Figure 8 showed the numbers of MPN *E.coli* /g in three replications. In the first and the third replication, it was less than 3 in all steps of each replication, whereas in the second replication it was 3.6 in step 1 and after that it was less than 3 in step 2 to 5.

Figure 9 showed the numbers of yeast, CFU /g in three replications. In the first replication, it was 250 CFU /g in step 1 and then decreased sharply to 20 CFU /g in both step 2 and 3 and still decreased to 10 CFU /g in step 4. In contrast, it increased rapidly to 130in step5. In the second replication, it was 2.0 x 10^4 CFU /g in step 1 then decreased sharply to 150 CFU /g and continued decreasing to 20 CFU /g in both step 3 and 4. On the other hand, it increased to 150 in step 5. For the third replication, it was 5.0 x 10^4 CFU /g in step 1, next it decreased rapidly to 20 and less than 10 in step 2 and 3 respectively. However, it increased slightly to 20 and 40 CFU /g in step 4 and 5 respectively.

Figure 10 showed the numbers of mold, CFU /g in three replications. It was less than 10 in step 1 to 5 of three replications.

For pathogenic organisms the number of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* were not detected in all steps of three replications.

The time of salad displaying

According to table 2 and figure 7,8,9 and 10 the microbiological quality of salad first displaying and after 2 hrs but mot more than 3 hrs of display showed that the number of MPN coliform /g increased from 3.6 to 15, 3.0 to 210.0 and 12.0 to 290.0 in the first, the second, and the third replication respectively. The number of MPN *E.coli* /g was less than 3 in both first displaying and after 2 hrs but not more than 3 hrs of display of three replications. The number of yeast CFU /g increased from 130 to 650, 150 to 250 and 40 to 150 CFU /g in the first, the second, and the third replication respectively, eventhough the number of mold CFU /g was less than 10

CFU /g in both first displaying and after 2 hrs but not more than 3 hrs of display of three replications.

For pathogenic organisms the number of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* were not detected in three replications.

Lettuce

Table 3 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of lettuce preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	>1,100	>1,100	1,100.0	34.0	1,100.0	290.0	$2.0x10^3$	$4.2x10^5$	$3.0x10^5$	10	10	10
2	>1,100	>1,100	460.0	28.0	150.0	53.0	150	$6.0x10^3$	$4.0x10^3$	<10	<10	<10
3	290.0	210.0	290.0	3.0	21.0	15.0	20	300	330	<10	<10	<10
4	>1,100	1,100	210.0	15.0	7.4	7.2	40	320	270	<10	<10	<10
5	>1,100	>1,100	>1,100	16.0	16.0	24.0	180	$7.0x10^3$	300	<10	<10	<10
6	>1,100	>1,100	>1,100	290.0	290.0	53.0	220	$1.0x10^5$	450	<10	<10	<10

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→ Plucking leave → cleaning → cutting → displaying → after displaying 2 hrs

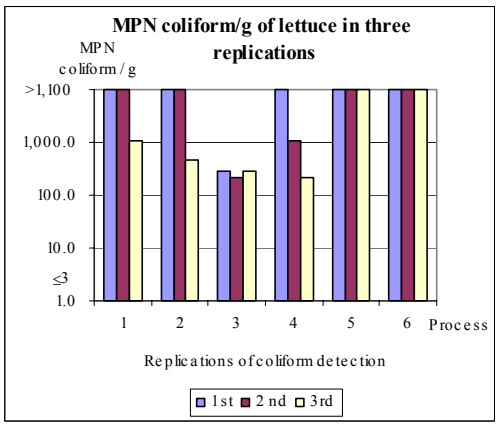

Figure 11 MPN coliform /g with three replications in each step of lettuce preparation.

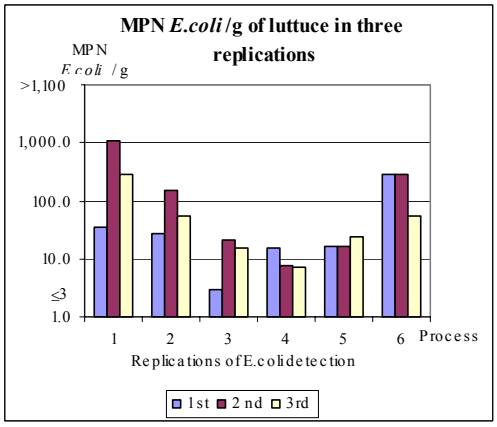

Figure 12 MPN *E.coli* /g with three replications in each step of lettuce preparation.

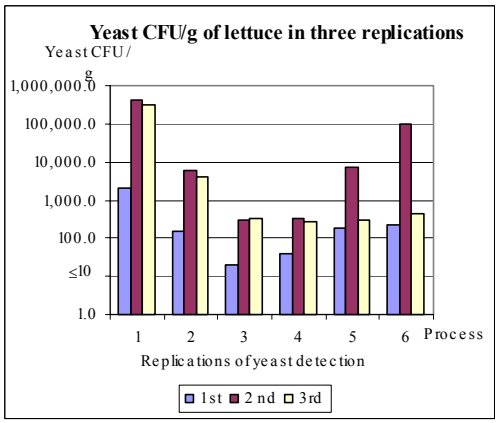

Figure 13 Yeast, CFU /g with three replications in each step of lettuce preparation.

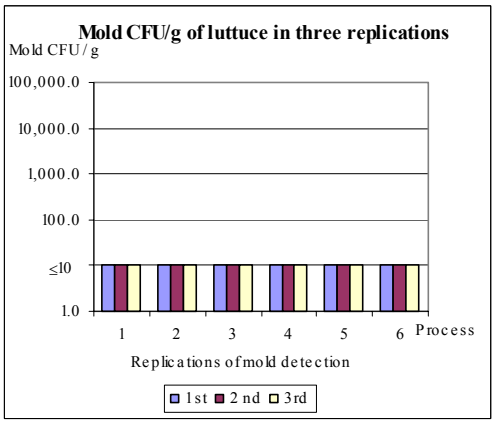

Figure 14 Mold, CFU /g with three replications in each step of lettuce preparation

The data in table 3 were presented by types of microbiological indicators in lettuce and also shown in Figure 11, 12, 13 and 14.

Preparation steps

Figure 11 showed the number of MPN coliform /g in three replications. In the first, replication it was more than 1,100 in both step 1 and step 2, then decreased sharply to 290 in step 3. In contrast, it increased to more than1,100 again in step 4and 5. In the second replication it was more than 1,100 in both step 1 and step2, then decreased rapidly to 210 in step 3. In step 4 it increased sharply to 1,100 and still increased to more than 1,100 in step 5. For the third replication, it was 1,100 in step 1 and decreased slightly to 210 in step 2, 3 and 4. Then, it increased sharply to more than 1,100 in step 5.

Figure 12 showed the number of MPN *E.coli* /g in three replications. In the first, replication it was 34 in step 1 then decreased to 28 and 3 in step 2 and 3 respectively. After that it increased to 15 in step 4 and still increased to 16 in step 5. In the second replication, the highest was 1,100 in step 1. Then it decreased rapidly in step 2, 3 and 4 to 7.4. Finally it increased sharply to 290 in step 5. In the third replication, it was 290 in step 1 and then decreased to 53, 15 and 7.2 in step 2, 3 and 4 respectively and after that it decreased slightly to 24 in step 5.

Figure 13 showed the number of yeast, CFU /g in three replications. In the first replication, it was $2x10^3$ CFU / g in step 1 and then decreased rapidly to 150 and 20 CFU / g in step 2 and 3 respectively. After step 3, it decreased to 40 and 180 CFU / g in step 4 and 5 respectively. In the second replication, the highest was $4.2x10^5$ CFU / g in step 1 then, decreased sharply to $6.0x10^3$ and 300 CFU /g in step 2 and 3 respectively. After that, it increased to 320 CFU / g in step 4 and increased rapidly to $7.0x10^3$ CFU / g in step 5. For the third replication, the highest was $3.0x10^5$ CFU / g in step 1, then decreased sharply to $4.0x10^3$, 330 and 270 CFU / g in step 2, 3 and 4 respectively. After that it increased slightly to 300 CFU / g in step 5.

Figure 14 showed the number of mold CFU /g in three replications. All of the replications were the same pattern which was described that the number of mold in step 1 was 10 CFU / g and then decreased to less than 10 CFU / g in step 2 to 5.

For pathogenic organisms, there was no growth of *Staphylococcus aureus* and *Salmonella spp*. On the other hand, the growth of *Vibrio cholerae* non 01 type was detected in the second and the third replication likewise the growth of *Clostridium perfringens* was detected in the first replication.

The time of salad displaying

According to table 3 and figure 11,12,13 and 14 the microbiological quality of salad first displaying and after 2 hrs but not more than 3 hrs of displaying showed that the number of MPN Coliform /g was more than 1,100 in three replications. The number of MPN *E.coli* /g increased from 16.0 to 290 in both first and second replication and also increased from 24.0 to 53.0 in third replication. The number of yeast CFU /g of salad first displaying and after 2 hrs but not more than 3 hrs of displaying increased from 180 to 220, 7.0×10^3 to 1.0×10^5 and 300 to 450 in first, second and third replication respectively. The number of mold CFU /g of salad first displaying and after 2 hrs but not more than 3 hrs of display was less than 10 in three replications.

For pathogenic organisms the number of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* were not detected in three replications.

Tomato

Table 4 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of tomato preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	>1,100	36.0	42.0	<3	<3	<3	<10	10	10	<10	10	10
2	23.0	15.0	39.0	<3	<3	<3	10	20	<10	<10	<10	<10
3	93.0	150.0	150.0	<3	3.0	<3	<10	<10	<10	10	<10	<10
4	>1,100	>1,100	53.0	3.6	7.2	3.6	$1x10^4$	$2.4x10^4$	$6.0x10^3$	20	<10	<10

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→ Cleaning → cutting → displaying → after displaying 2 hrs

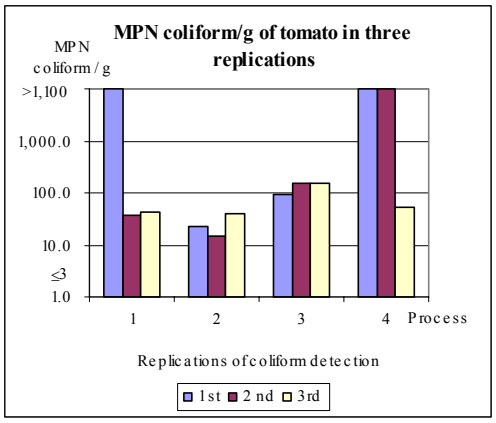

Figure 15 MPN coliform /g with three replications in each step of tomato preparation.

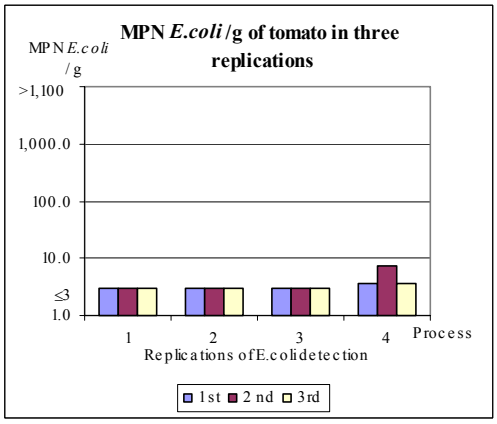

Figure 16 MPN *E.coli* /g with three replications in each step of tomato preparation.

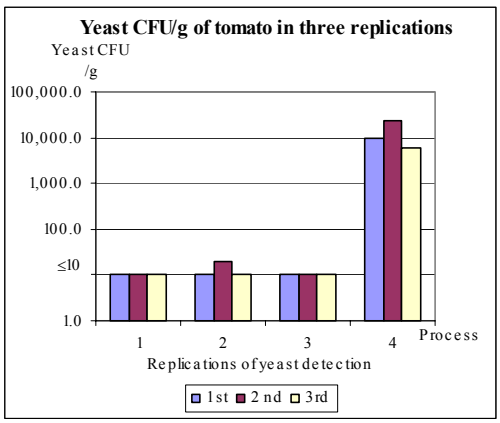

Figure 17 Yeast, CFU /g with three replications in each step of tomato preparation.

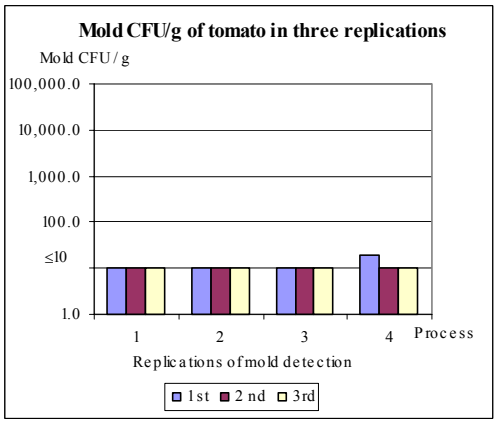

Figure 18 Mold, CFU /g with three replications in each step of tomato preparation

The data in table 4 were presented by types of microbiological indicators in tomato and also shown in Figure 15, 16, 17 and 18.

Preparation steps

Figure 15 showed the number of MPN coliform /g in three replications. In the first replication, it was more than 1,100 in step 1 and then decreased rapidly to 23 in step 2. After that it increased to 93 in step 3. For the second replication, it was 36 in step 1 then decreased slightly to 15 in step 2. After that it increased rapidly to 150 in step 3. For the third replication, it was 42 in step 1 and then decreased slightly to 39 in step 2. After that it increased sharply to 150 in step 3.

Figure 16 showed the number of MPN *E.coli* /g in three replications. The trend of the number of *E.coli* /g in the first and the third replication was quite the same as the number of *E.coli* /g with less than 3 in step 1, 2 and 3. But in the second replication, the number of *E.coli* was less than 3 in step 1 and 2 and then increased to 3 in step 3.

Figure 17 showed the number of yeast, CFU /g in three replications. In the first replication, the number was less than 10 CFU/g in step 1 then increased to 10 CFU/g in step 2. In contrast, in step 3 the number decreased again to less than 10 CFU/g. In the second replication, the number started from 10 CFU/g in step 1, then increased to 20 CFU/g in step 2. After that it decreased again to less than 10 CFU/g in step 3. For

the third replication the number was 10 CFU/g in step 1, then decreased to less than 10 CFU/g in step 2 and 3.

Figure 18 showed the number of mold CFU /g in three replications. In the first replication, the number was less than 10 CFU/g in step 1 and 2. Next it increased slightly to 10 CFU/g in step 3. For the second replication, the number was 10 CFU/g in step 1 and then decreased to less than 10 CFU/g in step 2 and 3. The trend in the third replication was also the same as in the second replication.

For pathogenic organisms, there was no growth of *Staphylococcus aureus*, *Salmonella spp.*, *Vibrio cholerae* and *Clostridium perfringens* in any steps of three replications.

The time of salad displaying

According to table 4 and figure 15,16,17 and 18 the microbiological quality of salad first displaying and after 2 hrs but not more than 3 hrs of display showed that the number of MPN coliform /g increased from 93 to more than 1,100 and 150 to more than 1,100 in the first and second replication respectively whereas in the third replication it was 150 at first displaying then decreased to 53 after 2 hrs but not more than 3 hrs of display. The number of MPN *E.coli* /g of first displaying and after 2 hrs but not more than 3 hrs of display increased from less than 3 to 3.6, 3.0 to 7.2, less than 3 to 3.6 in the first, second and third replication respectively. The number of yeast CFU /g was less than 10 in first displaying of three replication after display 2 hrs but not more than 3 hrs increased to 1.0×10^4, 2.4×10^4 and 6.0×10^3 CFU /g in the first, second and third replication respectively. The number of mold CFU /g was 10 CFU /g in first displaying then increased to 20 CFU /g after display 2 hrs but not more than 3 hrs in the first replication. It was less than 10 CFU /g in both first displaying and after display 2 hrs but not more than 3 hrs of both the second and third replications.

For pathogenic organisms, there was no growth of *Staphylococcus aureus*, *Salmonella spp*, *Vibrio cholerae* and *Clostridium perfringens* in any steps of three replications.

Onion

Table 5 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of onion preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	<3	3.6	3.0	<3	<3	<3	10	20	20	10	10	<10
2	<3	<3	3.0	<3	<3	<3	10	50	10	<10	<10	<10
3	28.0	64.0	23.0	<3	<3	<3	30	10	40	<10	<10	<10
4	43.0	150.0	23.0	<3	<3	<3	<10	<10	10	<10	<10	10
5	93.0	150.0	210.0	<3	3.0	<3	10	10	10	<10	<10	10

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→ Peeling → cleaning → cutting → displaying → after displaying 2 hrs

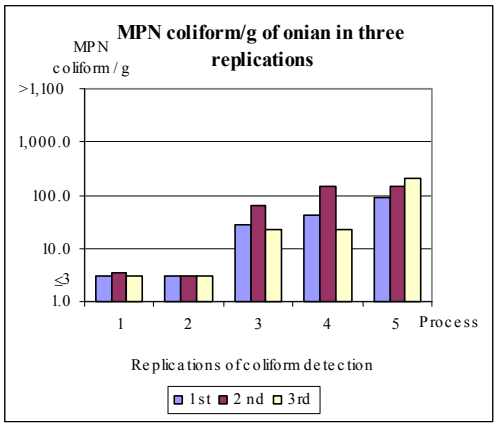

Figure 19 MPN coliform /g with three replications in each step of onion preparation.

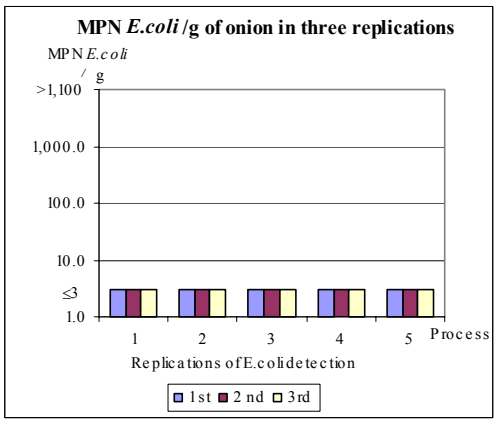

Figure 20 MPN *E.coli* /g with three replications in each step of onion preparation.

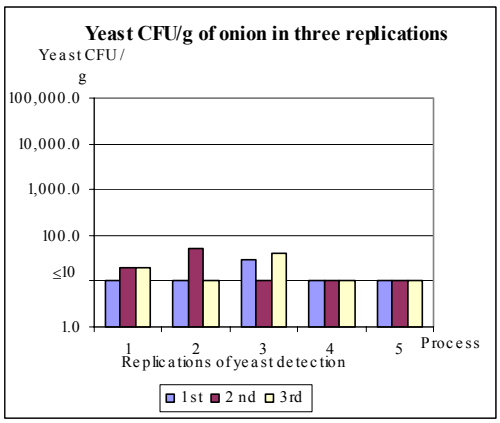

Figure 21 Yeast, CFU /g with three replications in each step of onion preparation.

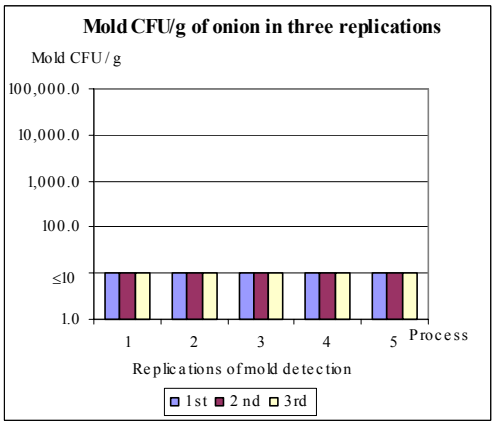

Figure 22 Mold, CFU /g with three replications in each step of onion preparation

The data in table 5 were presented by types of microbiological indicators in onion and also shown in Figure 19, 20, 21 and 22.

Preparation steps

Figure 19 showed the number of MPN coliform /g in three replications. In the first replication, it was less than 3 in step 1 and 2. Then it increased slightly to 28 and 43 in step 3, and 4 respectively. For the second replication, it was 3.6 in step 1, then decreased to less than 3 in step 2. After that it increased again to 6.4 and 150 in step 3 and 4 respectively. For the third replication, it was 3 in both step 1 and step 2. Then it increased to 23 in step 3 and 4.

Figure 20 showed the number of MPN *E.coli* /g in three replications. There was less than 3 in step 1 to 4 of both the first and the third replications. In the second replication there was less than 3 in step 1, 2, 3 and 4.

Figure 21 showed the number of yeast CFU /g in three replications. In the first replication, it was 10 CFU/g in both step 1 and step 2. Then it increased to 30 CFU/g in step 3, after that it decreased slightly to less than 10 CFU/g in step 4.

Figure 22 showed the number of mold CFU /g in three replications. In the first replication, it was 10 CFU/g in step 1 and then decreased to less than 10 CFU/g in step 2, 3 and 4; it was the same as in the second replication. For the third replication, it was less than 10 CFU/g in steps 1, 2 and 3. After that it increased to 10 CFU/g in step 4.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp.*, *Vibrio cholerae* and *Clostridium perfringens* in all steps of three replications.

The time of salad displaying

According to table 5 and figure 19,20,21 and 22 the microbiological quality of salad first displaying and after display 2 hrs but not more than 3 hrs of display showed that the number of MPN coliform /g increased from 43.0 to 93.0 and 23.0 to 210.0 in the first and third replication respectively. In the second replication it was 150 in both first displaying and after 2 hrs but not more than 3 hrs of display. The number of MPN *E.coli* /g of first displaying and after 2 hrs but not more than 3 hrs of display was less than 3 in both first displaying and after display 2 hrs but not more than 3 hrs of display of both the first and the third replication. It was less than 3 in first displaying of the second replication then slightly increased to 3 after display 2 hrs but not more than 3 hrs of display. The number of yeast CFU /g was less than 10 CFU /g in first displaying then slightly increased to 10 CFU /g after display 2 hrs but not more than 3 hrs of display of both the first and second replication. In the third replication it was 10 CFU /g in both first displaying and after 2 hrs but not more than 3 hrs of display. The number of mold CFU /g was less than 10 CFU /g of first displaying and after display 2 hrs but not more than 3 hrs of both the first and second replication. It was 10 CFU /g in both first displaying and after display 2 hrs but not more than 3 hrs of display of the third replication.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp.*, *Vibrio cholerae* and *Clostridium perfringens* in all steps of three replications.

Carrot

Table 6 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of carrot preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	<3	<3	<3	<3	<3	<3	$2.0x10^3$	150	$1.0 x10^3$	20	10	30
2	<3	<3	<3	<3	<3	<3	20	10	20	<10	20	10
3	<3	<3	<3	<3	<3	<3	10	10	20	<10	10	<10
4	3.6	7.4	3.0	3.6	3.0	<3	150	30	10	<10	<10	<10
5	39.0	43.0	20.0	39.0	38.0	20.0	100	10	150	<10	<10	<10
6	93.0	28.0	29.0	21.0	21.0	15.0	250	10	130	<10	10	10

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→ Peeling → cleaning → shredding → cleaning → displaying → after displaying 2 hrs

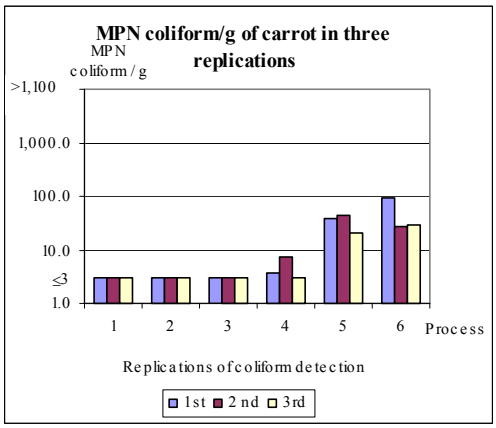

Figure 23 MPN coliform /g with three replications in each step of carrot preparation.

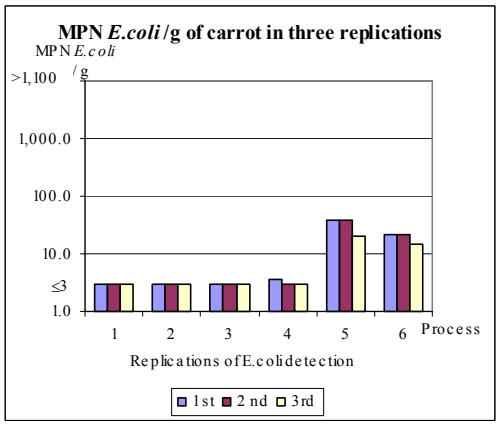

Figure 24 MPN *E.coli* /g with three replications in each step of carrot preparation.

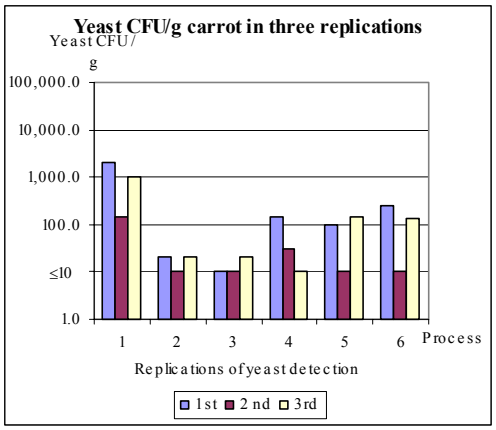

Figure 25 Yeast, CFU /g with three replications in each step of carrot preparation.

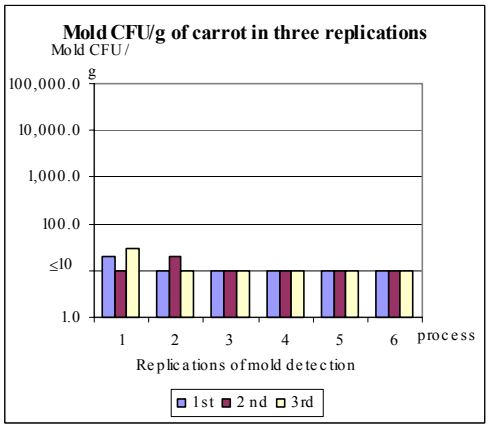

Figure 26 Mold, CFU /g with three replications in each step of carrot preparation

The data in table 6 were presented by types of microbiological indicators in carrot and also shown in figure 23, 24, 25 and 26

Preparation steps

Figure 23 showed the number of MPN coliform /g in three following replications. In the first replication, it started from less than 3 in step 1 and continued in the same level until step 3. After that it increased to 3.6 and 39 in step 4 and 5 respectively. In the second replication, it was less than 3 in step 1, 2 and 3. Then it increased slightly to 7.4 and 43 in step 4 and 5 respectively. In the second replication, it was less than 3 in step 1, 2 and 3 similar to the number in the first replication. After that it increased slightly to 3 and 20 in step 4 and 5 respectively.

Figure 24 showed the number of MPN *E.coli* /g in three replications. For the first replication, it was less than 3 in step 1, 2 and 3 then increased to 3.6 and 39 in step 4 and 5 respectively. In the second replication it showed the same pattern as the first replication. However, only step 4 was different which was 3. In the third replication, it was less than 3 in step 1, 2, 3 and 4. After that it increased to 20 in step 5.

Figure 25 showed the number of yeast CFU /g in three replications. In the first replication, it was 2.0 x 10^3 CFU /g in step 1. Next it decreased sharply to 20 and 10 CFU /g in step 2 and 3 respectively and then increased to 150 CFU /g in step 4. After

that it decreased to 100 CFU /g in step 5. In the second replication it was 150 CFU /g in step 1, then decreased rapidly to 10 CFU /g in both step 2 and step 3. Next it increased to 30 CFU /g in step 4 and then decreased again to 10 CFU /g in step 5. For the third replication, it was 1.0 x 10^3 CFU /g in step 1 and then decreased sharply to 20 CFU /g in both step 2 and step 3 and continued decreasing to 10 CFU /g in step 4. After that it increased to 150 CFU /g in step 5

Figure 26 showed the number of mold CFU /g in three replications. In the first replication, it was 20 CFU /g in step 1. After that it decreased to less than 10 CFU /g in step 2 to 6. For the second replication, it was 10 CFU /g in step 1 then increased to 20 CFU /g in step 2. Next in step 3 it decreased again to 10 CFU /g and continued decreasing to less than 10 in step 4 and 5 respectively. In the third replication, it was 30 CFU /g in step 1 then decreased to 10 CFU /g in step 2. After that continued decreasing to less than 10 CFU /g in step 3, 4 and 5.

For pathogenic organisms the number of *Staphylococcus aureus, Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* was not detected in all steps of each replication.

The time of salad display

According to table 6 and figure 23,24,25 and 26 the microbiological quality of salad first displaying and after 2 hrs but not more than 3 hrs of display showed that the number of MPN coliform /g increased from 39.0 to 93.0, 43.0 to 28.0 and 20.0 to 29.0 in the first, the second and the third replication respectively. The number of MPN *E.coli* /g decreased from39.0 to 21.0 an d38.0 to 21.0 in the first and the second replication respectively. It was 20 in first displaying of the third replication then decreased to 15.0 after 2 hrs but not more than 3 hrs of display. The number of yeast CFU /g increased from 100 to 250 CFU /g in the first replication while it was 10 CFU /g in both first displaying and after 2 hrs but not more than 3 hrs of display of the second replication. Whereas it was 150 CFU /g of first displaying after that decreased to 130 CFU /g after 2 hrs but not more than 3 hrs of display of the third replication. The number of mold CFU /g was less than 10 CFU /g in both first displaying and after 2 hrs but not more than 3 hrs of display. In both the second and the third replication, it

increased from less than 10 CFU /g of first displaying to 10 CFU /g after 2 hrs but not more than 3 hrs of display.

For pathogenic organisms the number of *Staphylococcus aureus, Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* was not detected in all steps of each replication.

Cabbage

Table 7 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of cabbage preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	460.0	210.0	290.0	43.0	21.0	20.0	<10	20	<10	<10	<10	<10
2	460.0	36.0	290.0	<3	<3	<3	<10	<10	10	<10	<10	<10
3	290.0	210.0	490.0	<3	<3	<3	<10	<10	<10	<10	<10	<10
4	>1,100	>1,100	1,100.0	14.0	15.0	15.0	<10	<10	<10	<10	<10	<10
5	>1,100	>1,100	>1,100	36.0	35.0	93.0	<10	<10	<10	<10	<10	10

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Peeling → cutting → putting in calcium hydroxide solution → displaying → ❺ after displaying 2 hrs

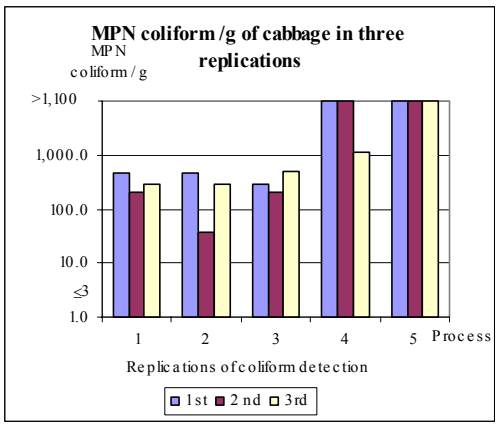

Figure 27 MPN coliform /g with three replications in each step of cabbage preparation.

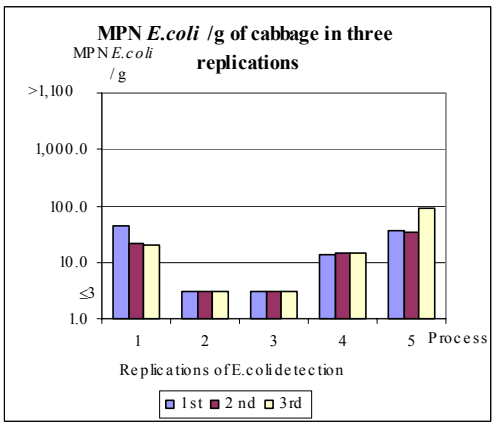

Figure 28 MPN *E.coli* /g with three replications in each step of cabbage preparation.

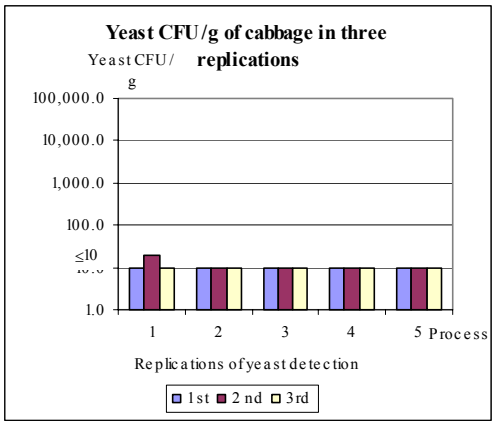

Figure 29 Yeast, CFU /g with three replications in each step of cabbage preparation.

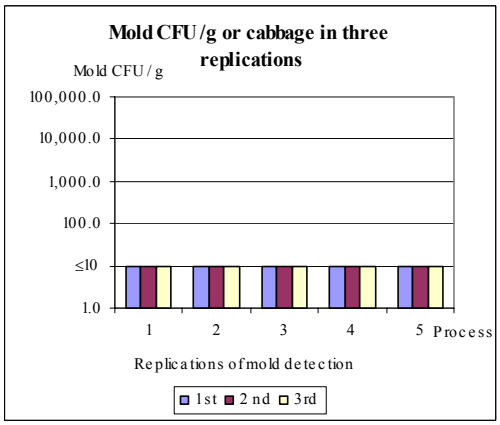

Figure 30 Mold, CFU /g with three replications in each step of cabbage preparation

The data in table 7 were presented by types of microbiological indicators in cabbage and also shown in Figure 27, 28, 29 and 30.

Preparation steps

Figure 27 showed the number of MPN coliform bacteria /g in three replications. In the first replication, it was 460 in both step 1 and step 2, next decreased to 290 in step 3. After that, it increased again to more than 1,100 in step 4. For the second replication, it was 210 in step 1, then decreased rapidly to 36 in step 2. After that it increased sharply to 210 again in step 3 and continued increasing to more than 1,100 in step 4.

Figure 28 showed the number of MPN *E.coli* /g in three replications. In the first replication, it was 43 in step 1 and then decreased to less than 3 in both step 2 and step 3. After that, it increased slightly to 14 in step 4. For the second replication, it was 21 in step 1 and then decreased to less than 3 in both step 2 and step 3. In contrast, it increased to 15 in step 4. In the third replication, it was 20 in step 1 then decreased to less than 3 in step 2 and 3. Finally it increased to 15 in step 4.

Figure 29 showed the number of yeast CFU /g in three replications. In the first replication, all of steps were less than 10 CFU /g. In the second replication, it was 20 CFU /g in step 1 and then decreased to less than 10 CFU /g in step 2, 3 and 4. For the

third replication, it was less than 10 in step 1 then increased to 10 CFU /g in step 2. After that it decreased again to less than 10 in step 3 and 4.

Figure 30 showed the number of mold CFU /g in three replications. It was less than 10 CFU /g in all steps of both the first and the second replications. In the third replication, it was less than 10 in step 1, 2, 3 and 4.

For pathogenic organisms the number of *Staphylococcus aureus, Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* was not detected in all steps of each replication.

Time of salad displaying

According to table 9 and figure 27,28,29 and 30 the microbiological quality of salad first displaying and after 2 hrs but not more than 3 hrs of display showed that the number of MPN coliform /g was more than 1,100 in both first displaying and after 2 hrs but not more than 3 hrs of display of both the first and the second replication. However it increased from 1,100 to more than 1,100 in the third replication. The number of MPN *E.coli*/g increased from 14.0 to 35.0, 15.0 to 35.0 and 15.0 to 93.0 in the first, the second and the third replication respectively. The number of yeast CFU /g was less than 10 CFU /gin both first displaying and after 2 hrs but not more than 3 hrs of display of three replications. The number of mold CFU /g was less than 10 CFU /g in both first displaying and after 2 hrs but not more than 3 hrs of display of the first and the second replications while it increased from less than 10 CFU /g to 10 CFU /g in the third replication.

For pathogenic organisms the number of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* was not detected in all steps of each replication.

Pineapple

Table 8 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of pineapple preparation.

Proces (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	460.0	210.0	93.0	<3	<3	<3	$2.0x10^4$	$4.0x10^3$	<10	10	30	<10
2	<3	<3	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10
3	<3	<3	<3	<3	<3	<3	<10	20	<10	<10	<10	<10
4	<3	<3	<3	<3	3.0	<3	<10	20	<10	<10	<10	<10
5	23.0	38.0	15.0	<3	<3	<3	<10	40	10	<10	<10	<10
6	460.0	160.0	35.0	43.0	43.0	<3	20	$2.0x10^3$	$1.0x10^3$	<10	<10	<10

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→ Peeling → cleaning → cutting → displaying → after displaying 2 hrs

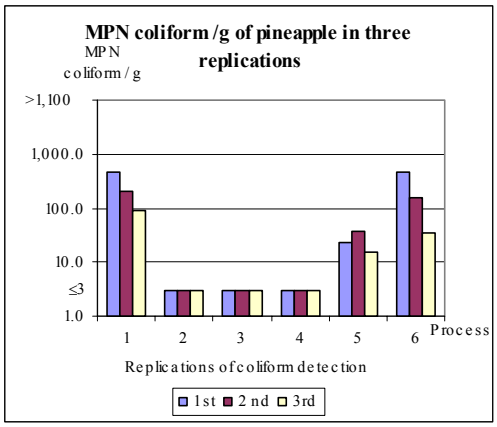

Figure 31 MPN coliform /g with three replications in each step of pineapple preparation.

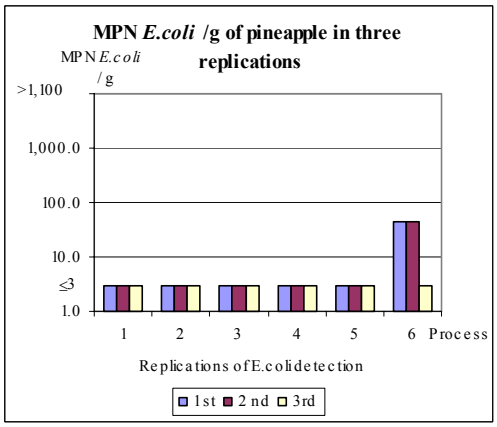

Figure 32 MPN *E.coli* /g with three replications in each step of pineapple preparation.

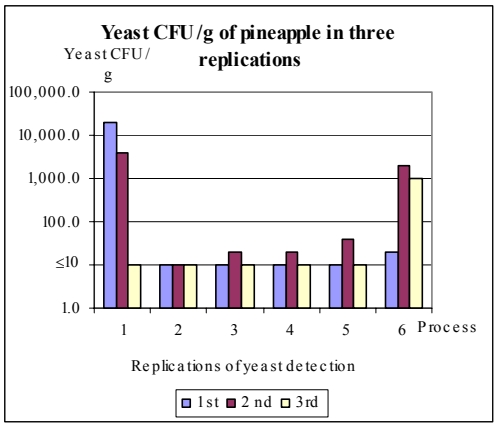

Figure 33 Yeast, CFU /g with three replications in each step of pineapple preparation.

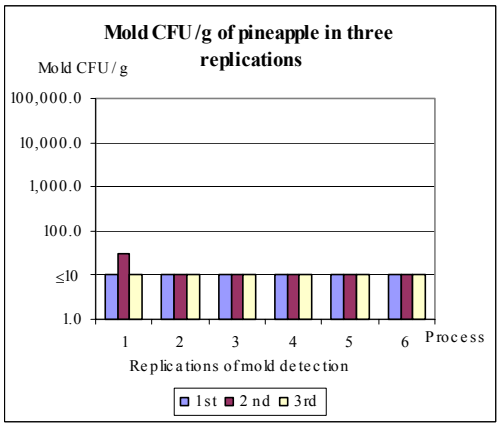

Figure 34 Mold, CFU /g with three replications in each step of pineapple preparation.

The data in table 8 were presented by types of microbiological indicators in pineapple and also shown in Figure 31, 32, 33 and 34.

Preparation steps

Figure 31 showed the number of MPN coliform /g in three replications. In the first replication, it was 460 in step 1, after that decreased to less than 3 in step 2, 3 and 4. Then it increased again to 23 in step 5. For the second replication it was 210 in step1, then decreased to less than 3 in step 2, 3 and 4. Next it increased to 38 in step 5. In the third replication, it was 93 in step 1 then decreased to less than 3 in step 2, 3 and 4. Finally it increased slightly to 15 in step 5.

Figure 32 showed the number of MPN *E.coli* /g in three following replications. For the first replication, it was less than 3 in step 1 to 5. In the second replication it was less than 3 in step 1, 2 and 3, then increased to 3 in step 4. After that it decreased again to less than 3 in step 5. In the third replication all of steps were less than 3.

Figure 33 showed the number of yeast, CFU /g in three replications. In the first replication, it was 2.0×10^4 CFU /g in step 1 and then decreased sharply to less than 10 in step 2 to 5. For the second replication it was 4.0×10^3 CFU /g in step 1, after that decreased rapidly to less than 10 in step 2. Next it increased to 2.0×10^3 CFU /g in

step 6. For the third replication, it was less than 10 CFU /g in step 1 to 4. Then it increased slightly to 10 CFU /g in step 5.

Figure 34 showed the number of mold CFU /g in three following replications. In the first replication, it was 10 CFU /g in step 1 after that decreased to less than 10 in step 2 to 5. For the second replication, which was the same pattern as the first replication it was 50 CFU /g in step 1, then decreased to less than 10 in step 2 to 5. In the third replication, all of steps were less than 3.

For pathogenic organisms, there was no growth of *Staphylococcus aureus*, *Salmonella spp*, *Vibrio cholerae* and *Clostridium perfringens* in any steps of three replications.

Time of salad displaying

According to table 10 and figure 31,32,33 and 34 the microbiological quality of salad first displaying and after 2 hrs but not more than 3 hrs of display showed that the number of MPN coliform /g increased from 23.0 to 460.0, 38.0 to 160.0 and 15.0 to 35.0 in the first, the second and the third replication respectively. The number of MPN *E.coli* /g increased from less than 3 to 43.0 in both the first and the second replication while, it was less than 3 in both first displaying and after 2 hrs but not more than 3 hrs of display of the third replication. The number of yeast CFU /g increased from less than 10 to 20, 40 to $2.0x10^3$ and 10 to $1.0x10^3$ CFU /g in the first, the second and the third replication respectively. The number of mold CFU /g was less than 10 in both first displaying and after 2 hrs but not more than 3 hrs of display of three replication.

For pathogenic organisms, there was no growth of *Staphylococcus aureus*, *Salmonella spp*, *Vibrio cholerae* and *Clostridium perfringens* in any steps of three replications.

Red kidney bean

Table 9 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of red kidney bean preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	<3	3.0	<3	<3	<3	<3	150	80	100	20	10	20
2	43.0	93.0	21.0	<3	3.0	<3	100	50	80	<10	<10	10
3	<3	15.0	6.2	<3	3.0	3.0	50	20	10	<10	<10	<10
4	460.0	240.0	150.0	<3	<3	<3	$1.0x10^3$	30	20	50	10	<10
5	>1,100	1,100.0	>1,100	<3	<3	<3	$2.0x10^3$	40	30	30	20	10

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→ Putting in water→ boiling→ displaying → after displaying 2 hrs

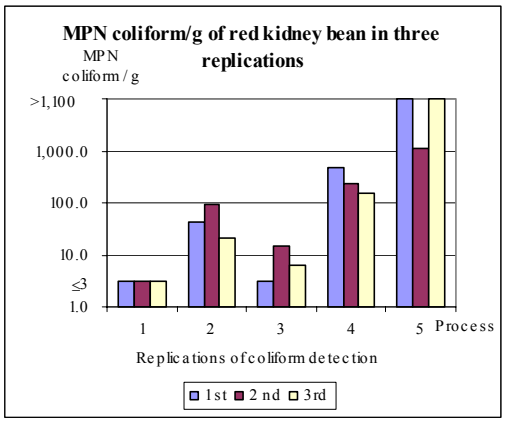

Figure 35 MPN coliform /g with three replications in each step of red kidney bean preparation.

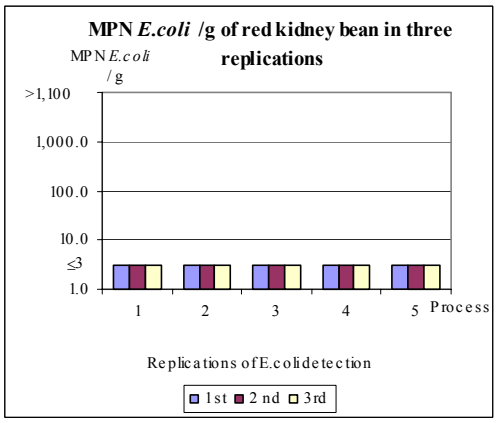

Figure 36 MPN *E.coli* /g with three replications in each step of red kidney bean preparation.

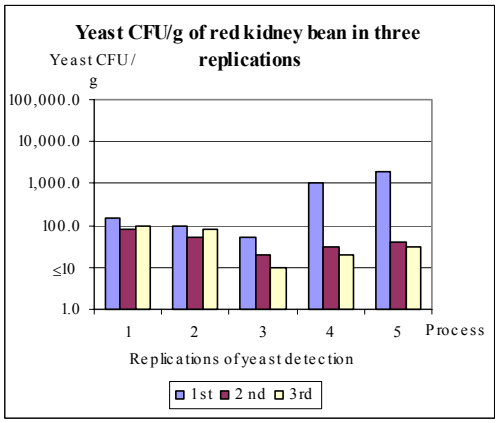

Figure 37 Yeast, CFU /g with three replications in each step of red kidney bean preparation.

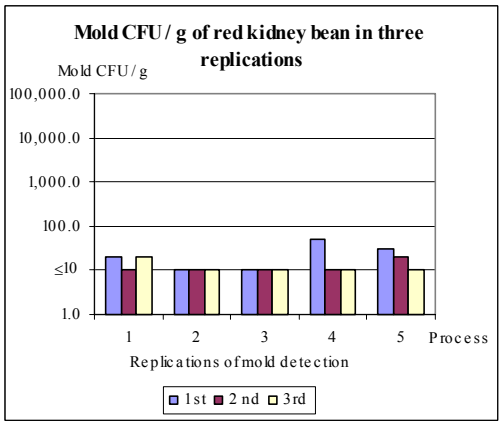

Figure 38 Mold, CFU /g with three replications in each step of red kidney bean preparation

The data in table 9 were presented by types of microbiological indicators in red kidney bean and also shown in Figure 35, 36, 37 and 38.

Preparation steps

Figure 35 showed the number of MPN coliform /g in three replications. In the first replications, the number was less than 3 in step 1 then increased to 43 in step 2. After that it decreased to less than 3 again in step 3. In contrast, it was increased sharply to 460 and more than 1,100 in step 4. For the second replication, it was 3 in step 1. Then it increased to 93 in step 2, next it decreased to 15 in step 3, however in step 4 it increased again to 240. For the third replication, it was less than 3 in step 1. After that it increased to 21 in step 2 and then decreased to 6.2 in step 3. In contrast in step 4 it increased to 150.

Figure 36 showed the number of MPN *E.coli* /g in three replications. In the first replication, the number of *E.coli* was less than 3 in all steps. For the second replication, it was less than 3 in step 1 and then increased slightly to 3 in both step 2 and step 3. After that it decreased again to less than 3 in step 4. For the third replication, it was less than 3 in both step 1 and step 2. However it increased slightly to 3 in step 3, finally the number decreased slightly to less than 3 again in step 4.

Figure 37 showed the number of yeast CFU /g in three replications. In the first replication, it was 150 CFU /g in step 1 then decreased slightly to 100 and 50 in step 2

and 3 respectively. After that it increased rapidly to 1x 10^3 CFU /g in step 4. For the second replication, it was 80 CFU /g in step 1, next decreased slightly to 50 and 20 CFU /g in step 2 and 3 respectively. Finally it increased to 20 CFU /g in step 4.

Figure 38 showed the number of mold CFU /g in three replications. In the first replication, it was 20 CFU /g in step 1 then decreased to 10 CFU /g in both step 2 and step 3. In contrast, it increased to 50 CFU /g in step 4. In the second replication, it was 10 CFU /g in step 1 then decreased slightly to less than 10 CFU /g in both step 2 and step 3. However, it increased again to 10 CFU /g in step 4.

For pathogenic organisms the growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* was not detected in all steps of each replication.

Time of salad displaying

According to table 7 and figure 35,36,37 and 38 the microbiological quality of salad first displaying and after 2 hrs but not more than 3 hrs of display showed that the number of MPN coliform /g increased from 460.0 to more than 1,100, 240.0 to 1,100 and 150.0 to more than 1,100 in the first, the second and the third replication respectively. The number of MPN *E.coli* /g was less than 3 in both first displaying and after 2 hrs but not more than 3 hrs of display in three replications. The number of yeast CFU /g increased from 1.0x10^3 to 2.0 x 10^3, 30 to 40 and 20 to 30 in the first, the second and the third replication respectively. The number of mold CFU /g increased from 50 to 30, 10 to 20 and less than 10 to 10 in the first, the second and the third replication respectively.

For pathogenic organisms the growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* was not detected in all steps of each replication.

Boiled egg

Table 10 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of boiled egg preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	<3	<3	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10
2	<3	<3	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10
3	53.0	290.0	290.0	11	11	7.3	<10	<10	<10	<10	10	<10

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→ Boiling→ peeling → displaying → after displaying 2 hrs

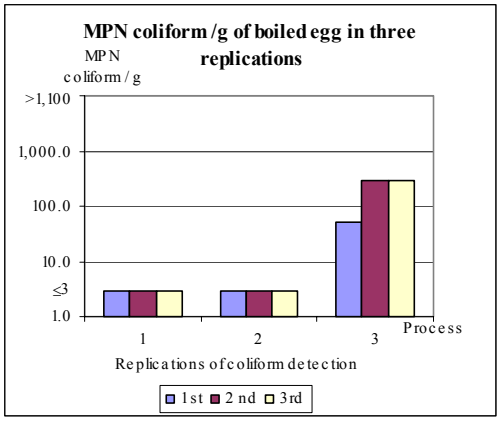

Figure 39 MPN coliform /g with three replications in each step of boiled egg preparation.

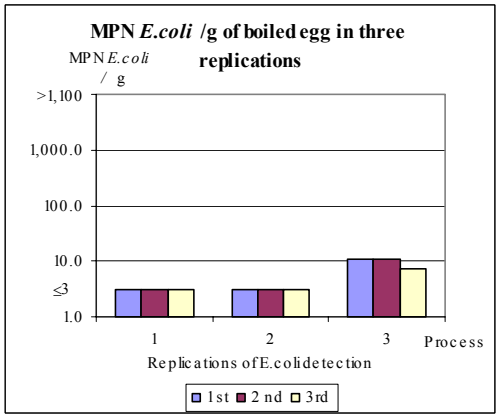

Figure 40 MPN *E.coli* /g with three replications in each step of boiled egg preparation.

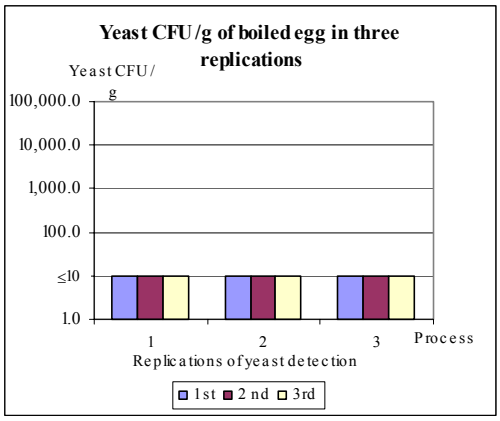

Figure 41 Yeast, CFU /g with three replications in each step of boiled egg preparation.

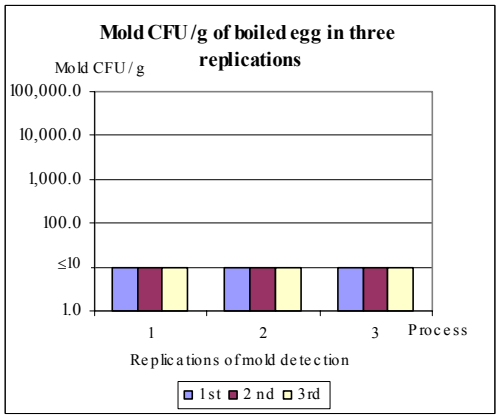

Figure 42 Mold, CFU /g with three replications in each step of boiled egg preparation

The data in table 10 were presented by types of microbiological indicators in boiled egg and also shown in Figure 39, 40, 41 and 42.

Preparation steps

Figure 39 showed the number of MPN coliform /g in three replications. In the first replication, it was less than 3 in step 1 and 2. In the second and the third replications, it was also less than 3 in both step 1 and step 2.

Figure 40 showed the number of MPN *E.coli* /g in three replications. In the first replication, it was less than 3 in both step 1 and step 2. In the second and the third replications, the number was also the same as in the first replication.

Figure 41 showed the number of yeast, CFU /g in three replications. It was less than 10 CFU /g in all steps of three replications.

Figure 42 showed the number of mold CFU /g in three replications. In both the first and the third replications, it was less than 10 CFU /g in each steps. For the second replication it was less than 10 CFU /g in both step 1 and step 2.

For pathogenic organisms, there was no growth of *Staphylococcus aureus*, *Salmonella spp.*, *Vibrio cholerae* and *Clostridium perfringens* in any steps of three replications.

Time of salad displaying

According to table 8 and figure 39,40,41 and 42 the microbiological quality of salad first displaying and after 2 hrs but not more than 3 hrs of display showed that the number of MPN coliform /g increased from less than 3 to 53.0 in the first replication and less than 3 to 290.0 in both the second and the third replication. The number of MPN *E.coli* /g increased from less than 3 to 11 in both the first and the second replication and from less than 3 to 7.3 in the third replication. The number of yeast CFU /g was less than 10 CFU /g in both first displaying and after 2 hrs but not more than 3 hrs of display. The number of mold CFU /g was less than 10 CFU /g in both first displaying and after 2 hrs but not more than 3 hrs of display in both the first and the third replication. Whereas it increased from less than 10 to 10 in the second replication.

For pathogenic organisms, there was no growth of *Staphylococcus aureus*, *Salmonella spp*, *Vibrio cholerae* and *Clostridium perfringens* in any steps of three replications.

Barley

Table 11 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of barley preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	<3	7.4	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10
2	<3	<3	<3	<3	<3	<3	<10	<10	10	<10	<10	<10
3	<3	<3	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10
4	36.0	<3	210.0	<3	<3	<3	<10	<10	<10	<10	<10	<10
5	>1,100	460.0	1,100.0	11.0	20.0	7.2	<10	<10	<10	<10	<10	<10

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→ Putting in water → boiling → displaying → after displaying 2 hrs

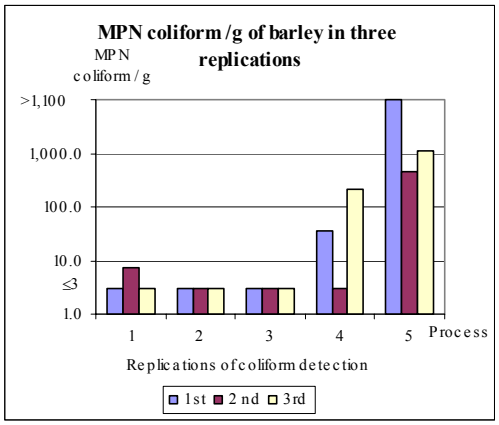

Figure 43 MPN coliform /g with three replications in each step of barley preparation.

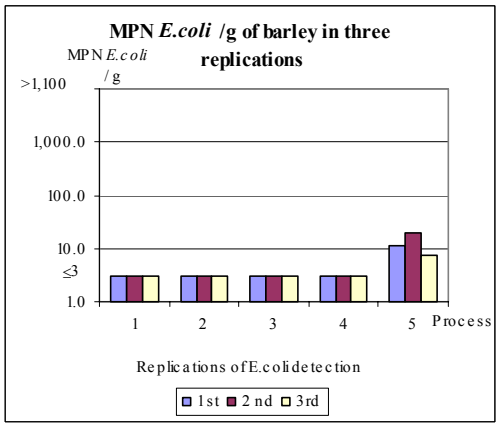

Figure 44 MPN *E.coli* /g with three replications in each step of barley preparation.

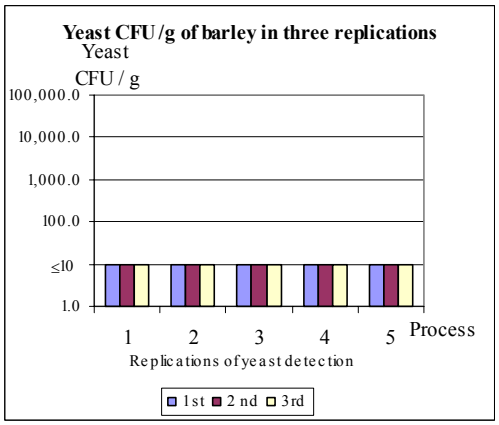

Figure 45 Yeast, CFU /g with three replications in each step of barley preparation.

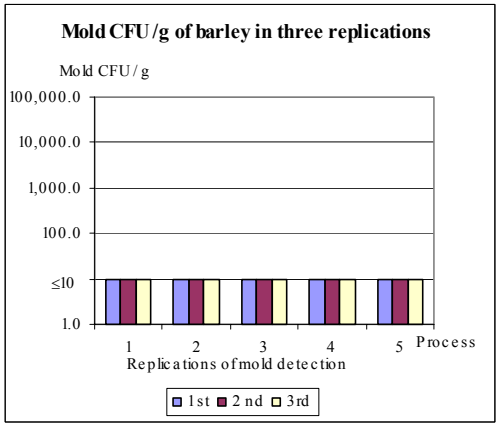

Figure 46 Mold, CFU /g with three replications in each step of barley preparation.

The data in table 11 were presented by types of microbiological indicators in barley and also shown in Figure 43, 44, 45 and 46.

Preparation steps

Figure 43 showed the number of MPN coliform /g in three replications. In the first replication, it was less than 3 in step 1, 2 and 3 then increased to 36 in step 4. In the second replication, it was 7.4 in step 1 then decreased to less than 3 in step 2, 3 and

4. For the third replication, it was less than 3 in step 1, 2 and 3 after that increased to 210 in step 4.

Figure 44 showed the number of MPN *E.coli* /g in three replications. It was the same pattern of number in all replications. It was less than 3 in step 1 to 4.

Figure 45 showed the number of yeast, CFU /g in three replications. In both the first and the second replication, it was less than 10 CFU /g in all steps. For the third replication, almost of steps were less than 10 CFU /g excluded in step 2 which was 10 CFU/g.

Figure 46 showed the number of mold CFU /g in three replications. It was less than 10 CFU /g in each step of three replications.

For food-borne pathogens *Salmonella* type E was detected in step 2 of the first replication

Time of salad displaying

According to table 11 and figure 43,44,45 and 46 the microbiological quality of salad first displaying and after 2 hrs but not more than 3 hrs of display showed that the number of MPN coliform /g increased from 36.0 to more than 1,100, less than 3 to 460.0 and 210.0 to 1,100 in the first, the second and the third replication respectively. The number of MPN *E.coli* /g increased from less than 3 to 11.0, 20.0 and 7.2 in the first, the second and the third replication respectively. The number of yeast CFU /g was less than 10 CFU /g in both first displaying and after 2 hrs but not more than 3 hrs of display of three replications. The number of mold CFU /g was less than 10 CFU /g in both first displaying and after 2 hrs but not more than 3 hrs of display of three replications.

For pathogenic organisms in the second replication *Staphylococcus aureus* was detected in both step 4 and step 5.

Boiled sweet potato

Table 12 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of boiled sweet potato preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	>1,100	1,100.0	210.0	150.0	3.0	<3	$6.3x10^4$	$5.0x10^4$	$3.0x10^4$	30	50	20
2	150.0	13.0	16.0	14.0	6.0	<3	650	250	$8.2x10^2$	10	10	<10
3	6.1	9.0	13.0	<3	<3	<3	350	300	100	<10	<10	<10
4	<3	<3	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10
5	150.0	290.0	24.0	11	15.0	11.0	300	30	20	<10	<10	<10
6	>1,100	>1,100	>1,100	53	210.0	42.0	350	100	200	<10	10	10

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→ Peeling → cutting → cleaning → streaming → displaying → after displaying 2 hrs

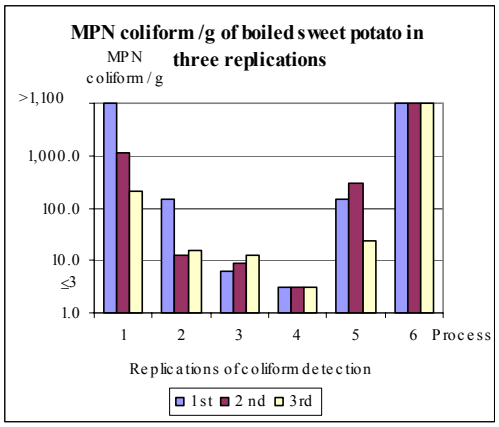

Figure 47 MPN coliform /g with three replications in each step of boiled sweet potato preparation.

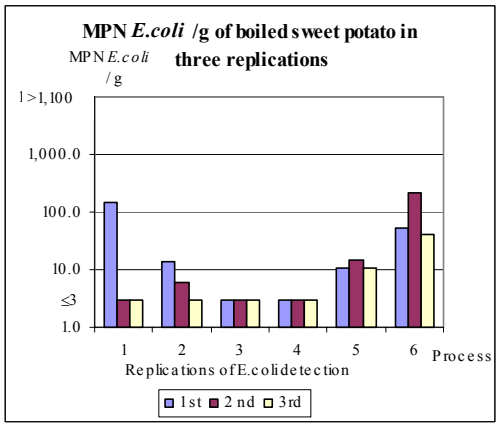

Figure 48 MPN *E.coli* /g with three replications in each step of boiled sweet potato preparation.

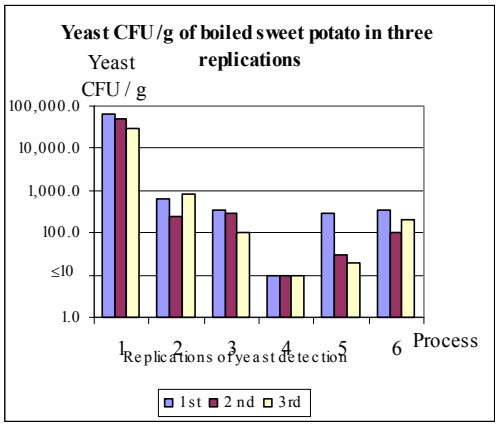

Figure 49 Yeast, CFU /g with three replications in each step of boiled sweet potato preparation.

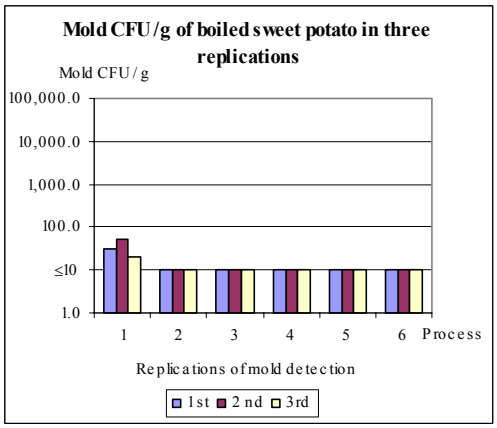

Figure 50 Mold, CFU /g with three replications in each step of boiled sweet potato preparation.

The data in table 12 were presented by types of microbiological indicators in boiled sweet potato and also shown in Figure 47, 48, 49 and 50.

Preparation steps

Figure 47 showed the number of MPN coliform /g in three replications. In the first replication, it was more than 1,100 in step 1, then decreased rapidly to 150, 6.1 and less than 3 in step 2, 3 and 4 respectively. However, in step 5 it decreased sharply to 150. For the second replication, it was 1,100 in step 1 then decreased sharply to 13, 9 and less than 3 in step 2, 3 and 4 respectively. On the contracy it increased rapidly to 290 in step 5. In the third replication, it was 210 in step 1 and then decreased slightly to 16, 13 and less than 3 in step 2, 3 and 4 respectively. After that it increased to 24 in step 5.

Figure 48 showed the number of *E.coli* /g in three replications. In the first replication, it was 150 in step 1, then decreased slightly to 14 in step 2. Next it was less than 3 in both step 3 and step 4. After that it increased in 11 in step 5. In the second replication, it was 3 in step 1 then increased to 6 in step 2 however in step 3 and 4 it decreased to less than 3. Finally it increased to 15 in step 5. For the third replication, it was less than 3 in step 1, 2, 3 and 4 then increased slightly to 11 in step 5.

Figure 49 showed the number of yeast CFU /g in three replications. In the first replication, it was 6.3 x 10^4 CFU /g in step 1 then decreased sharply to 650, 350 and less than 10 CFU /g in step 2, 3 and 4 respectively. After that it increased to 300 in step 5. In the second replication, it was 5.0 x 10^4 CFU /g in step 1 and then decreased rapidly to 250 CFU /g in step 2. Next it increased to 300 in step 3 however decreased rapidly to less than 10 in step 4. Finally it increased again to 30 CFU /g in step 5. In the third replication it was 3.0 x 10^4 CFU /g in step 1 then decreased rapidly to 820, 100 and less than 10 in step 2, 3 and 4 respectively. After that it increased slightly to 20 in step 5.

Figure 50 showed the number of mold in three replications. In the first replication, it was 30 CFU /g in step 1 and then decreased to 10 in step 2 and continued slightly decreasing to less than 3 in step 3 to 5. For the second replication it was 50 CFU /g in step 1 then decreased to 10 CFU /g in step 2 and less than 10 CFU /g in step 3, 4 and 5. In the third replication, it was 20 CFU /g in step 1 and decreased to less than 10 CFU /g in step 2, 3, 4 and 5.

For pathogenic organisms, there was no growth of *Staphylococcus aureus*, *Salmonella spp*, *Vibrio cholerae* and *Clostridium perfringens* in any steps of three replications.

Time of salad displaying

According to table 12 and figure 47,48,49 and 50 the microbiological quality of salad first displaying and after 2 hrs but not more than 3 hrs of display showed that the number of MPN coliform /g increased from 150.0, 290.0 and 24.0 to more than 1,100 in the first, the second and the third replication respectively. The number of MPN *E.coli* /g increased from 11.0 to 53.0, 15.0 to 210.0 and 11.0 to 42.0 in the first, the second and the third replication respectively. The number of yeast CFU /g increased from 300 to 350, 30 to 100 and 20 to 200 CFU /g in the first, the second and the third replication respectively. The number of mold CFU /g was less than 10 CFU /g in both first displaying and after 2 hrs but not more than 3 hrs of display whereas, it was less than 10 CFU /g in first displaying then increased to 10 CFU /g after 2 hrs but not more than 3 hrs of display in both the second and the third replications.

For pathogenic organisms, there was no growth of *Staphylococcus aureus*, *Salmonella spp*, *Vibrio cholerae* and *Clostridium perfringens* in any steps of three replications.

Corn

Table 13 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of corn preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	>1,100	>1,100	1,100.0	1,100.0	210.0	290.0	$6.5x10^5$	$4.0x10^5$	$3.0x10^4$	<10	10	<10
2	<3	<3	<3	<3	<3	<3	<10	10	<10	<10	<10	<10
3	150.0	75.0	16.0	3.0	<3	<3	20	20	<10	<10	<10	<10
4	>1,100	>1,100	>1,100	>1,100	1,100	210.0	50	500	300	20	10	10

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→ Boiling → displaying → after displaying 2 hrs

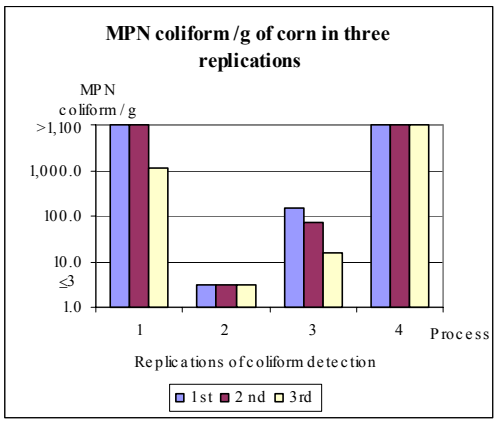


Figure 51 MPN coliform /g with three replications in each step of corn preparation.

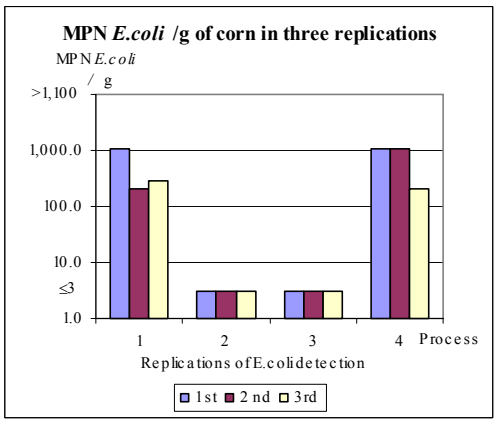


Figure 52 MPN *E.coli* /g with three replications in each step of corn preparation.

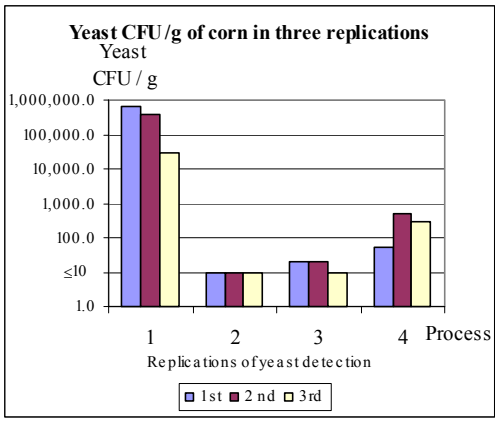


Figure 53 Yeast, CFU /g with three replications in each step of corn preparation.

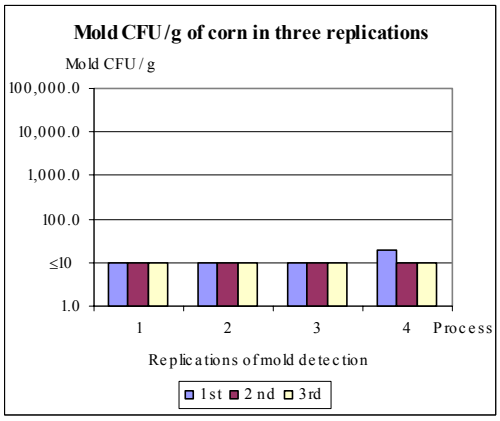


Figure 54 Mold, CFU /g with three replications in each step of corn preparation.

The data in table 13 were presented by types of microbiological indicators in corn and also shown in Figure 51, 52, 53 and 54.

Preparation steps

Figure 51 showed the number of MPN coliform /g in three replications. In the first replication, it was more than 1,100 in step 1, then decreased rapidly to less than 3 in step 2. After that it increased to 150 in step 3. In the second replication also the same as the first replication excluded step 3 which was 75. For the third replication it was 1,100 in step 1, then decreased sharply to less than 3 in step 2. Finally it increased to 16 in step 3.

Figure 52 showed the number of MPN *E.coli* /g in three replications. In the first replication, it was 1,100 in step 1, then decreased rapidly to less than 3 in step 2. In contrast, it increased to 3 in step 3. In the second replication it was 210 in step 1 and then decreased to less than 3 in both step 2 and step 3. For the third replication, it was 290 in step 1, then decreased to less than 3 in both step 2 and step 3.

Figure 53 showed the number of yeast CFU /g in three replications. In the first replication, it was 6.5 x 10^5 CFU /g in step 1, then decreased rapidly to less than 10 in step 2. After that it increased slightly to 20 CFU /g in step 3. For the second replication, it was 4.0 x 10^5 CFU /g in step 1, next decreased sharply to 10 in step 2.

Then it increased to 20 CFU /g in step 3. In the third replication, it was 3.0 x 10^4 CFU /g in step 1 and then decreased sharply to less than 10 CFU /gin both step 2 and step 3.

Figure 54 showed the number of mold CFU /g in three following three replications. In the first replication, it was less than 10 CFU /g in step 1, 2 and 3. In the second replication it was 10 CFU /g in step 1 then decreased slightly to less than 10 CFU /g in both step 2 and step 3. For the third replication it was less than 10 CFU /g in step 1, 2 and 3.

For pathogenic organisms the number of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* was not detected in all steps of each replication.

Time of salad displaying

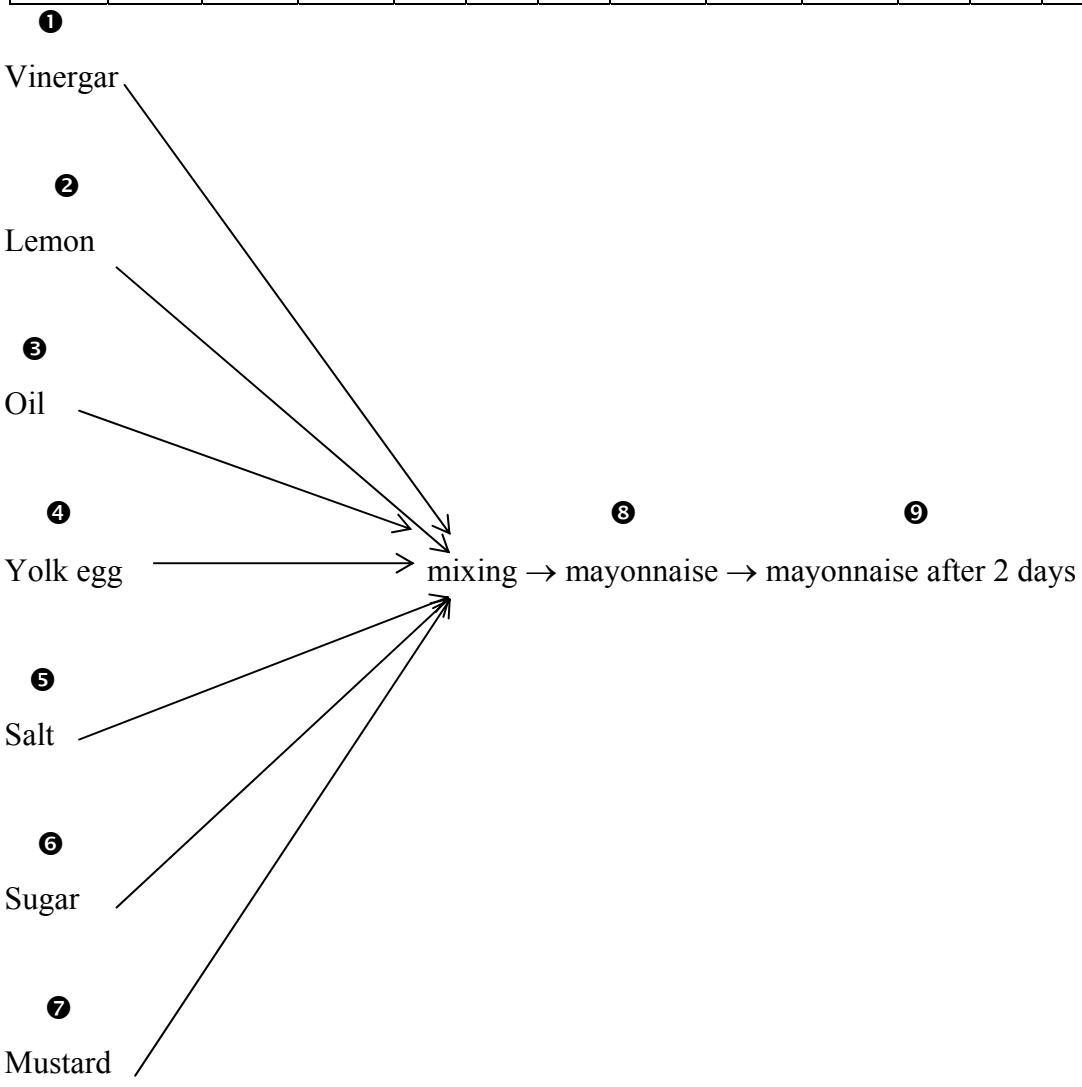
According to table 13 and figure 51, 52, 53 and 54 the microbiological quality of salad first displaying and after 2 hrs but not more than 3 hrs of display showed that the number of MPN coliform /g increased form 150.0 to more than 1,100, 75 to 1,100 and 16 to more than 1,100 in the first, the second and the third replication respectively. The number of *E.coli* /g increased from 3 to more than 1,100, less than 3 to 1,100 and less than 3 to 210 in the first, the second and the third replication respectively. The number of yeast CFU /g increased from 20 to 50, 20 to 500 and less than 10 to 300 in the first, the second and the third replication respectively. The number of mold CFU /g increased from less than 10 to 20 in the first replication and increased to 10 in both the second and the third replication.

For pathogenic organisms the number of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* was not detected in all steps of each replication.

Mayonnaise dressing

Table 14 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of mayonnaise preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	<3	<3	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10
2	<3	<3	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10
3	<3	<3	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10
4	<3	<3	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10
5	<3	<3	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10
6	<3	<3	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10
7	<3	<3	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10
8	<3	<3	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10
9	<3	<3	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10



The data in table 14 was presented by type of microbiological indicators in mayonnaise dressing shown that the number of MPN coliform bacteria /g and MPN *E.coli* /g in three replications was less than 3 in all steps of three replications. The number of yeast and mold, CFU /g in three replications was less than 10 CFU /g in each step of three replications.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in all steps of three replications.

4.2 Microbiological Quality of salad bar in supermarket

Cucumber

Table 15 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of cucumber preparation

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	<3	3.6	3.0	<3	<3	<3	<10	200	120	<10	<10	<10
2	<3	<3	<3	<3	<3	<3	<10	50	30	<10	<10	<10
3	3.6	<3	<3	<3	<3	<3	80	50	30	<10	<10	<10
4	15.0	15.0	<3	<3	<3	<3	<10	500	30	<10	<10	<10
5	23.0	20.0	14.0	<3	<3	<3	<10	600	180	<10	<10	10

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→ Peeling → cleaning → slicing → displaying → after displaying 2 hrs

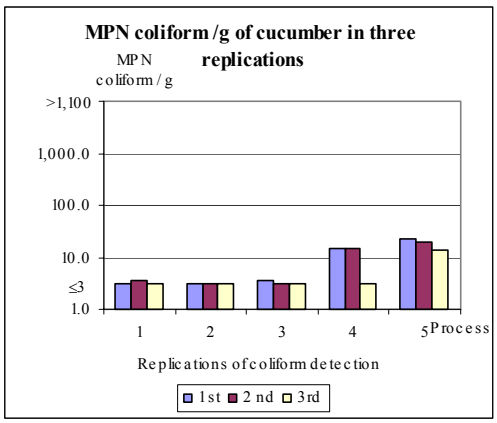

Figure 55 MPN coliform /g with three replications in each step of cucumber preparation.

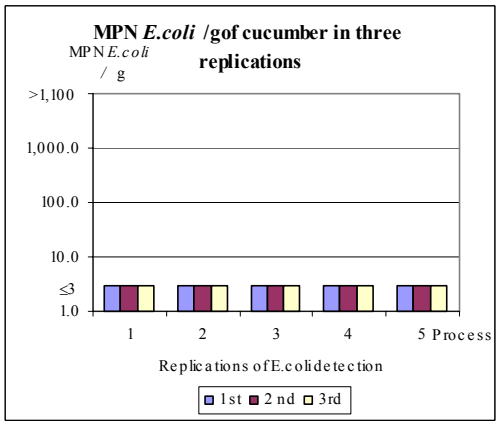

Figure 56 MPN *E.coli* /g with three replications in each step of cucumber preparation.

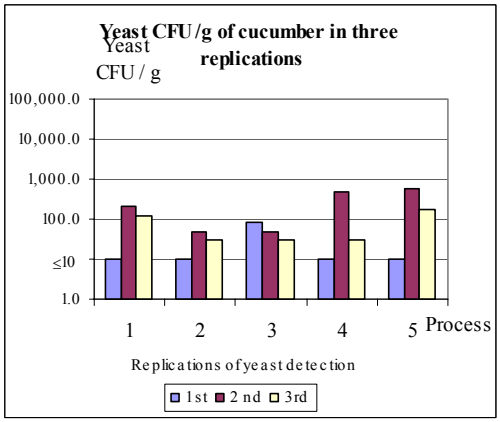

Figure 57 Yeast, CFU /g with three replications in each step of cucumber preparation.

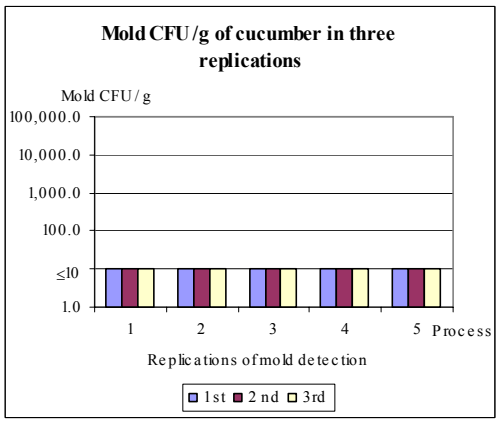

Figure 58 Mold, CFU /g with three replications in each step of cucumber preparation.

The data in table 15 were presented by types of microbiological indicators in cucumber and also shown in Figure 55, 56, 57 and 58

Preparation steps

Figure 55 showed the number of MPN coliform /g in three replications. In the first replication, it was less than 3 in both step 1 and step 2, after that it increased slightly to 3.6 and 15 in step 3, and 4 respectively. In second replication, it was 3.6 in step 1 then decreased to less than 3 in step 2, 3 and 4.

Figure 56 showed the number of MPN *E.coli* /g in three replications. It was less than 3 in all steps of three replications.

Figure 57 showed the number of yeast CFU /g in three following replications. In the first replication, it was less than 10 CFU /g in both step 1 and step 2 then increased to 80 CFU /g. After that it decreased to less than 10 in step 4. In the second replication, it was 200 in step 1 then decreased to 50 in both step 2 and step 3. After that it increased sharply to 500 in step 4. For the third replication, it was 120 CFU /g in step 1 and then decreased to 30 CFU /g in step 2, 3 and 4.

Figure 58 showed the number of mold CFU /g in three replications. It was less than 10 CFU /g in all steps of both the first and the second replications. In the third replication, it was less than 10 CFU /g in step 1 to 4.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in all steps of three replications.

Time of salad displaying

According to table 15 and figure 55,56,57 and 58 the microbiological quality of salad first displaying and after 2 hrs but not more than 3 hrs of display showed that the number of MPN coliform /g increased from15.0 to 23.0, 15.0 to 20.0 and less than 3 to14.0 in the first, the second and the third replication respectively. The number of MPN *E.coli* /g increased from less than 3 to 14.0 in the first replication whereas it was less than 3 in both first displaying and after 2 hrs but not more than 3 hrs of display of both the second and the third replication. The number of yeast CFU /g was less than 10 CFU /g in both first displaying and after 2 hrs but not more than 3 hrs of display of the first replication, however it increased from 500 to 600 and 30 to 180 CFU /g in the second and the third replication respectively. The number of mold CFU /g was less than 10 in both first displaying and after 2 hrs but not more than 3 hrs of display of the first and the second replication while it was less than 10 CFU /g of first displaying then increased to 10 CFU /g after 2 hrs of displaying but not more than 3 hrs of display of the third replication.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in all steps of three replications.

Tomato

Table 16 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of tomato preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	9.1	7.4	43.0	<3	<3	<3	10	20	10	<10	<10	<10
2	<3	<3	15.0	<3	<3	<3	<10	10	<10	<10	<10	<10
3	23.0	43.0	14.0	<3	<3	<3	<10	<10	<10	<10	<10	<10
4	>1,100	1,100.0	290.0	<3	<3	<3	<10	<10	<10	<10	<10	<10

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→ Cleaning → slicing → displaying → after displaying 2 hrs

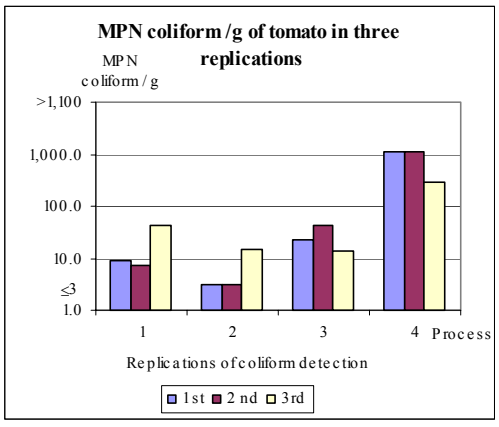

Figure 59 MPN coliform /g with three replications in each step of tomato preparation.

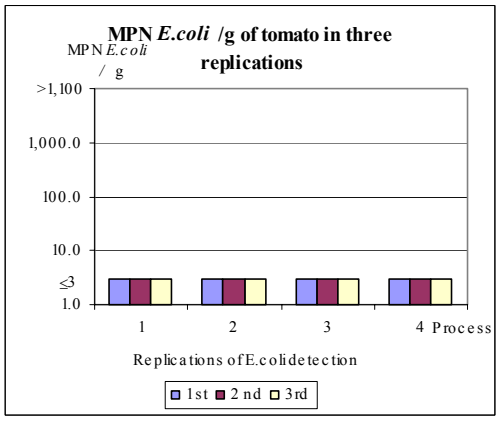

Figure 60 MPN *E.coli* /g with three replications in each step of tomato preparation.

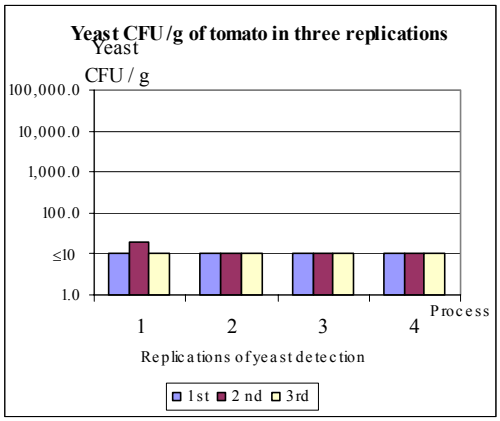

Figure 61 Yeast, CFU /g with three replications in each step of tomato preparation.

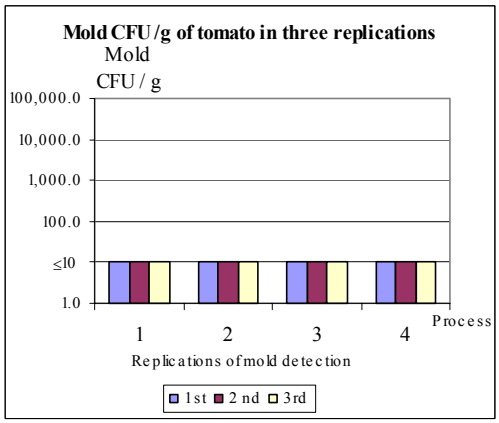

Figure 62 Mold, CFU /g with three replications in each step of tomato preparation.

The data in table 16 were presented by types of microbiological indicators in tomato and also shown in Figure 59, 60, 61 and 62.

Preparation steps

Figure 59 showed to number of MPN coliform /g in three following replications. In the first replication, it was 9.1 in step 1 and then decreased to less than 3 in step 2. After that increased to 23 in step 3. In the second replication, it was 7.4 in step 1, next decreased to less than 3 in step 2. In contrast, it increased to 43 in step 3. For the third replication, it was 43 in step 1 then decreased to 15 and 14 in step 2 and 3 respectively.

Figure 60 showed the number of MPN *E.coli* /g in three replications. It was less than 3 in all steps of three replications.

Figure 61 showed the number of yeast CFU /g in three replications. In the first replication, it was 10 CFU /g in step 1 and then decreased slightly to less than 10 CFU /g in step 2 and 3. In the second replication, it was 20 CFU /g in step and then decreased to CFU /g in step 2 and still decreased to less than 10 CFU /g in step 3. In the third replication it was 10 CFU /g in step 1 and decreased to less than 10 CFU /g in step 2 and 3.

Figure 62 showed the number of mold CFU /g in three replications. It was less than 10 CFU /g in each step of three replications.

For pathogenic organisms the number of *Staphylococcus aureus*, *Salmonella spp., Vibrio cholerae* and *Clostridium perfringens* was not detected in all steps of each replication.

Time of salad displaying

According to table 16 and figure 59,60,61 and 62 the microbiological quality o f salad first displaying and after 2 hrs but not more than 3 hrs of display showed that the number of MPN coliform /g increased from 23.0 to 1,100, 43.0 to 1,100 and 14.0 to 290.0 in the first, the second and the third replication respectively. The number of MPN *E.coli* /g was less than 3 in both first displaying and after 2 hrs but not more than 3 hrs of display of three replications. The number of yeast CFU /g was less than 10 CFU/g in both first displaying and after 2 hrs but not more than 3 hrs of display of three replications. The number of mold CFU /g was less than 10 CFU /g in both first displaying and after2 hrs but not more than 3 hrs of display of three replications.

For pathogenic organisms the number of *Staphylococcus aureus, Salmonella spp., Vibrio cholerae* and *Clostridium perfringens* was not detected in all steps of each replication.

Onion

Table 17 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of onion preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	15.0	7.4	<3	<3	<3	<3	$2.0x10^3$	$2.3x10^3$	$1.5x10^3$	10	10	20
2	<3	<3	<3	<3	<3	<3	120	900	150	<10	<10	20
3	<3	<3	<3	<3	<3	<3	20	200	300	<10	<10	<10
4	<3	20.0	21.0	<3	<3	<3	210	$2.0 x10^3$	$1.7 x10^3$	20	<10	<10
5	9.1	21.0	11.0	<3	<3	<3	$7.2 x10^3$	$5.0 x10^3$	$3.0 x10^3$	30	10	10

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→ Peeling → cleaning → slicing → displaying → after displaying 2 hrs

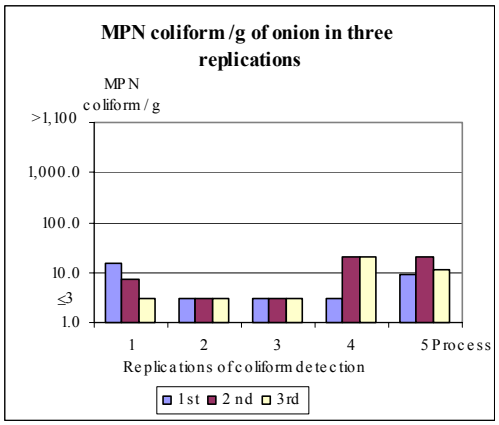

Figure 63 MPN coliform /g with three replications in each step of onion preparation.

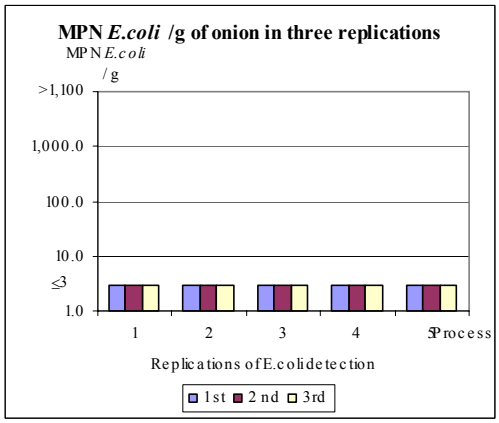

Figure 64 MPN *E.coli* /g with three replications in each step of onion preparation.

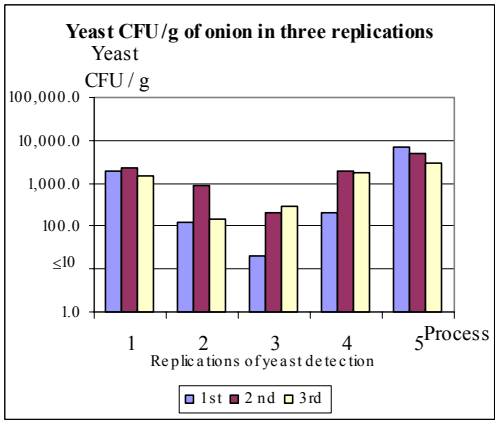

Figure 65 Yeast, CFU /g with three replications in each step of onion preparation.

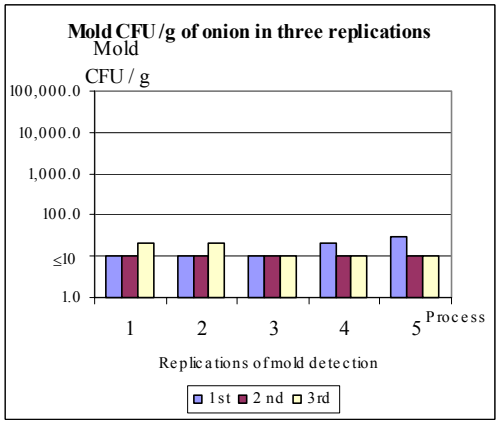

Figure 66 Mold, CFU /g with three replications in each step of onion preparation.

The data in table 17 were presented by types of microbiological indicators in onion and also shown in Figure 63, 64, 65 and 66

Preparation steps

Figure 63 showed the number of MPN coliform /g in three replications. In the first replication, it was 15 in step 1 and then decreased slightly to less than 3 in step 2, 3 and 4. In the second replication, it was 7.4 in step 1 then decreased to less than 3 in

both step 2 and step 3. After that it increased to 20 in step 4. For the third replication, it was less than 3 in step 1, 2 and 3 then increased to 21 in step 4.

Figure 64 showed the number of MPN *E.coli* /g in three replications. It was less than 3 in each step of three replications.

Figure 65 showed the number of yeast CFU /g in three following replications. In the first replication, it was 2.0 x 10^3 CFU /g in step 1 then decreased slightly to 120 and 20 CFU /g in step 2 and 3 respectively. After that it increased rapidly to 210 CFU /g in step 4. In the second replication, it was 2.3 x 10^3 CFU /g in step 1 and then decreased sharply to 900 and 200 CFU /g in step 2 and 3 respectively. Next it decreased rapidly to 2.0 x 10^3 CFU /g in step 4. For the third replication, it was 1.5 x 10^3 CFU /g in step 1 next decreased rapidly to 150 CFU /g in step 2. After that it decreased to 300 CFU /g in step 3 and still increased to 1.7 x 10^3 CFU /g in step 4.

Figure 66 showed the number of mold CFU /g in three replications. In the first replication, it was 10 CFU /g then decreased slightly to less than 10 CFU /g in both step 2 and step 3. In contrast, it increased slightly to 20 CFU /g in step 4. In the second replication, it was 10 CFU /g in step 1 and then decreased slightly to less than 10 CFU /g in step 2, 3 and 4. For the third replication, it was 20 CFU /g in both step 1 and step 2 then decreased slightly to less than 10 CFU /g in both step 3 and step 4.

For pathogenic organisms the number of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* was not detected in all steps of three replications.

Time of salad displaying

According to table 17 and figure 63,64,65 and 66 the microbiological quality of salad first displaying and after display2 hrs but not more than 3 hrs of display showed that the number of MPN coliform /g increased from less than 3 to 9.1, 20.0 to 21.0 in the first and the second replication respectively. However it decreased from 21.0 to 11.0 in the third replication. The number of MPN *E.coli* /g was less than 3 in both first displaying and after 2 hrs but not more than 3 hrs of display of three replications. The number of yeast CFU /g increased from210 to 7.2x103, 2.0 x103 to 5.0x103 and 1.7x103 to 3.0x103 CFU /g in the first, the second and the third

replication respectively. The number of mold CFU /g increased from 20 to 30 in the first replication and less than 10 to 10 in both the second and the third replication.

For pathogenic organisms the number of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* was not detected in all steps of three replications.

Lettuce

Table 18 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of lettuce preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	1,100.0	>1,100	1,100.0	210.0	210.0	150.0	$2.5x10^5$	$1.0x10^5$	$2.2x10^5$	10	<10	<10
2	1,100.0	21.0	1,100.0	16.0	7.4	29.0	$1.0x10^5$	$1.2x10^5$	$1.8x10^5$	<10	<10	<10
3	3.6	3.0	3.6	<3	<3	<3	100	200	300	<10	10	<10
4	15.0	11.0	11.0	<3	<3	<3	150	300	400	30	<10	10

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→ Cutting → cleaning → displaying → after displaying 2 hrs

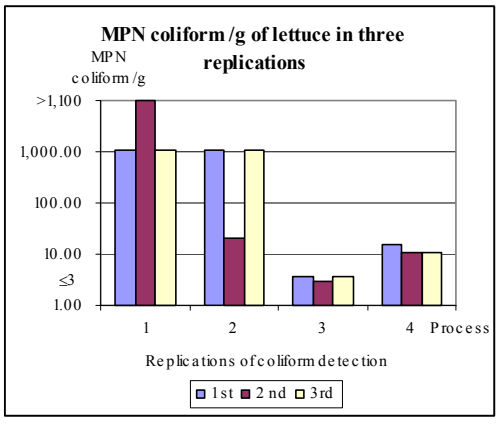

Figure 67 MPN coliform /g with three replications in each step of lettuce preparation.

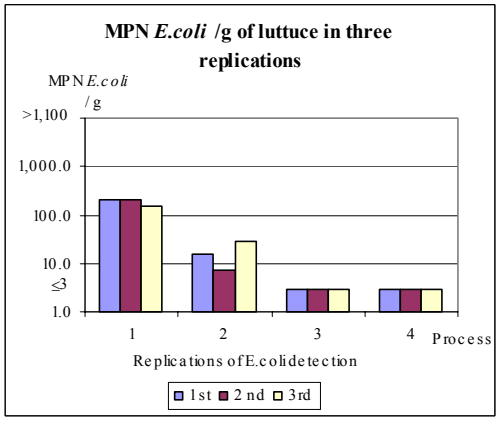

Figure 68 MPN *E.coli* /g with three replications in each step of lettuce preparation.

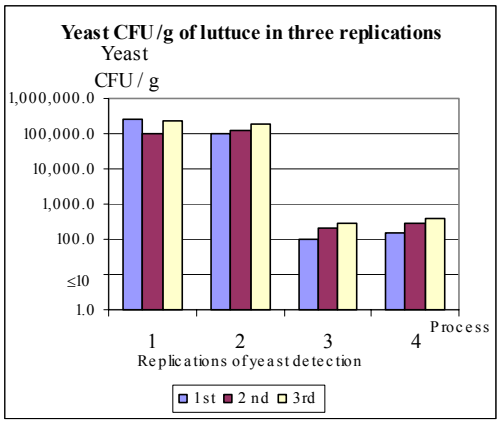

Figure 69 Yeast, CFU /g with three replications in each step of lettuce preparation.

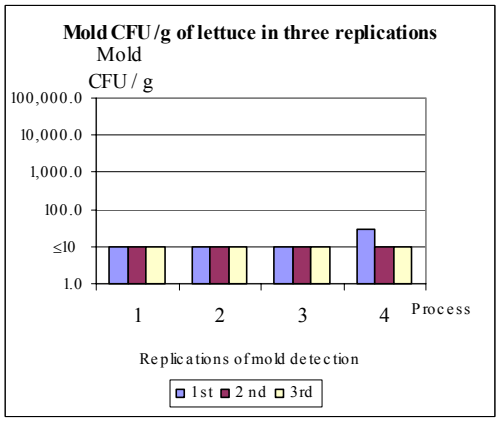

Figure 70 Mold, CFU /g with three replications in each step of lettuce preparation.

The data in table 19 were presented by types of microbiological indicators in lettuce and also shown in Figure 67, 68, 69 and 70.

Preparation steps

Figure 67 showed the number of MPN coliform /g in three replications. In the first replication, it was 1,100 in both step 1 and step 2, then decreased rapidly to 3.6 in step 3. In the second replication, it was more than 1,100 in step 1 and then decreased sharply to 21 and 3 in step 2 and 3 respectively. For the third replication, it was 1,100 in both step 1 and step 2 then decreased rapidly to 3.6 in step 3.

Figure 68 showed the number of MPN *E.coli* /g in three replications. In the first replication, it was 210 in step 1, then decreased to 16 in step 2 and still decreased to less than 3 in step 3. In the second replication, it was 210 in step 1 same as in the first replication then decreased to 7.4 in step 2 and continued decreasing to less than 3 in step 3. For the third replication, it was 150 in step 1 then decreased to 29 in step 2 and still decreased to less than 3 in step 3.

Figure 69 showed the number of yeast CFU /g in three replications. In the first replication, it was 2.5 x 10^5 CFU /g in step 1, then decreased slightly to 1.0 x 10^5 CFU /g in step2. After that it decreased sharply to 100 CFU /g in step 3. In the second replication it was 1.0 x 10^5 CFU /g in step 1 then increased slightly to 1.2 x 10^5 CFU /g in step 2. After that it decreased rapidly to 200 CFU /g in step 3. For the third

replication, it was 2.2 x 10^5 CFU /g in step 1, then the number decreased slightly to 1.8 x 10^5 CFU /g. In contrast, it decreased sharply to 300 in step 3.

Figure 70 showed the number of mold CFU /g in three following replications. In the first replication, it was 10 CFU /g in step 1 and then decreased slightly to less than 10 CFU /g in both step 2 and step 3. In the second replication, it was less than 10 CFU /g in both step 1 and step 2, then increased to 10 CFU /g in step3. For the third replication, it was less than 10 CFU /g in step 1, 2 and 3.

For pathogenic organisms the number of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* was not detected in all steps of three replications.

Time of salad displaying

According to table 19 and figure 67,68,69 and 70 the microbiological quality of salad first displaying and after 2 hrs but not more than 3 hrs of display showed that the number of MPN coliform /g increased from 3.6 to 15.0, 3.0 to 11.0 and 3.6 to 11.0 in the first, the second and the third replication respectively. The number of MPN *E.coli* /g was less than 3 in both first displaying and after display 2 hrs but not more than 3 hrs of display of three replications. The number of yeast CFU /g increased from 100 to 150, 200 to 300 and 300to 400 in the first, the second and the third replication respectively. The number of mold CFU /g increased from less than 10 to 30 and less than10 to10 in the first and the third replication respectively whereas, it decreased from 10 to less than 10 in the third replication.

For food-borne pathogens the number of *Staphylococcus aureus, Salmonella spp., Vibrio cholerae* and *Clostridium perfringens* was not detected in all steps of three replications.

Pineapple

Table 19 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of pineapple preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	93.0	75.0	29.0	<3	<3	<3	30	50	20	30	10	20
2	<3	7.2	<3	<3	<3	<3	20	20	10	<10	<10	<10
3	<3	<3	<3	<3	<3	<3	20	30	20	10	10	10

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→ Peeling → cutting → displaying → after displaying 2 hrs

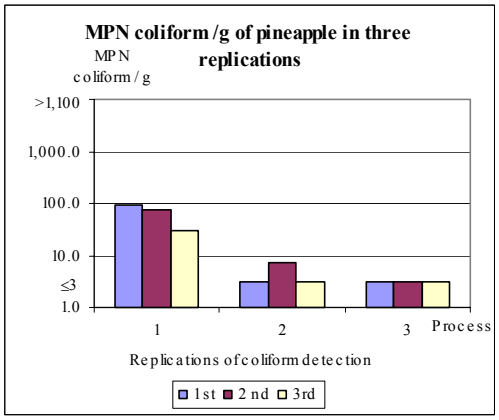

Figure 71 MPN coliform /g with three replications in each step of pineapple preparation.

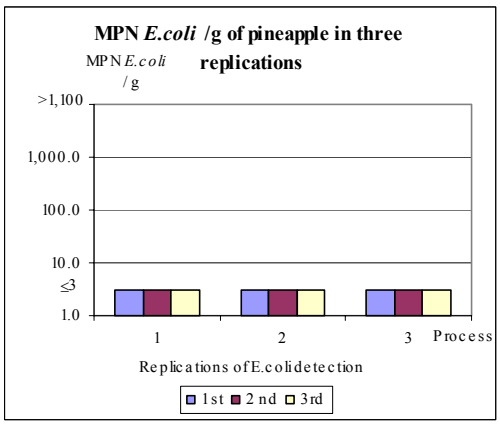

Figure 72 MPN *E.coli* /g with three replications in each step of pineapple preparation.

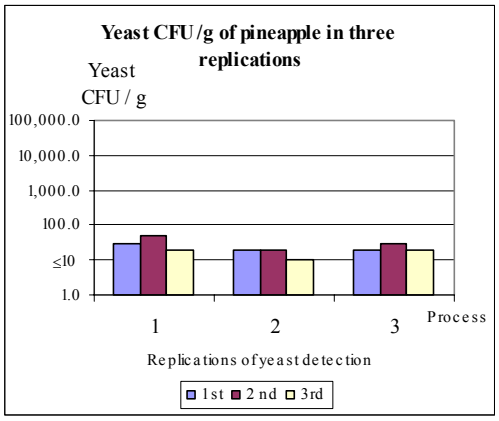

Figure 73 Yeast, CFU /g with three replications in each step of pineapple preparation.

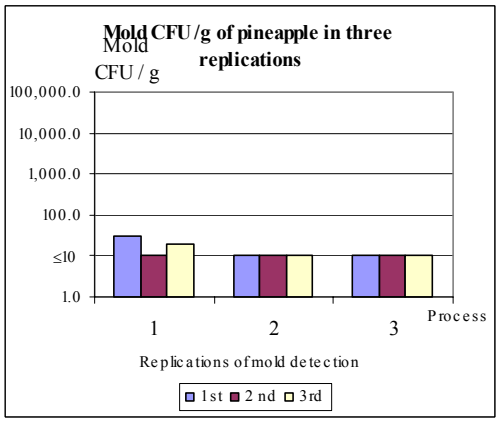

Figure 74 Mold, CFU /g with three replications in each step of pineapple preparation.

The data in table 20 were presented by types of microbiological indicators in pineapple and also shown in Figure 71, 72, 73 and 74.

Preparation steps

Figure 71 showed the number of MPN coliform /g in three replications. In the first replication, it was 93 in step 1 and then decreased sharply to less than 3 in step 2. In the second replication, it was 75 in step 1, then decreased to 7.2 in step 2. For the third replication, it was 29 in step 1 then decreased to less than 3 in step 2.

Figure 72 showed the number of MPN *E.coli* /g in three replications. It was less than 3 in each step of three replications.

Figure 73 showed the number of yeast CFU /g in three following replications. In the first replication, it was 30 CFU /g in step 1, then decreased slightly to 20 in step 2. In the second replication, it was 50 CFU /g in step 1, then decreased to 20 CFU /g in step 2. In the third replication, it was 20 CFU /g in step 1, then decreased slightly to 10 CFU /g in step 2.

Figure 74 showed the number of mold CFU /g in three replications. In the first replication, it was 30 CFU /g in step 1, then decreased slightly to less than 10 CFU /g in step 2. In the second replication, it was 10 CFU /g in step 1, then decreased slightly to less than 10 CFU /g in step 2. In the third replication, it was 20 CFU /g in step 1, then decreased slightly to less than 10 CFU /g in step 2.

For pathogenic organisms there was no growth of *Stapylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in all steps of three replications.

Time of salad displaying

According to table 20 and figure 71,72,73 and 74 the microbiological quality of salad first displaying and after 2 hrs but not more than 3 hrs of display showed that the number of MPN coliform /g was less than 3 in both first displaying and after display 2 hrs but not more than 3 hrs of display of both the first and the third replication while it decreased from 7.2 to less than 3 in the second replication. The number of MPN *E.coli* /g was less than 3 in both first displaying and after 2 hrs but not more than 3 hrs of display of three replications. The number of yeast CFU /g was 20 CFU /g in both first displaying and after 2 hrs but not more than 3 hrs of display of the first replication however it increased from 20 to 30 and 10 to 20 CFU /g in the second and the third replication respectively. The number of mold CFU /g increased from less than 10 to 10 CFU /g in three replications.

For pathogenic organisms there was no growth of *Stapylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in all steps of three replications.

Cantaloupe

Table 20 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of cantaloupe preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	>1,100	210.0	1,100.0	35.0	14.0	28.0	10	10	20	<10	<10	<10
2	<3	21.0	26.0	<3	<3	<3	<10	<10	<10	<10	<10	<10
3	9.3	240.0	460.0	<3	<3	<3	<10	20	<10	<10	<10	<10

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→ Peeling → cutting → displaying → after displaying 2 hrs

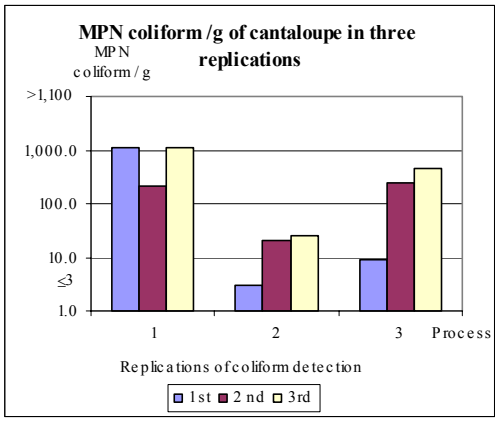

Figure 75 MPN coliform /g with three replications in each step of cantaloupe preparation.

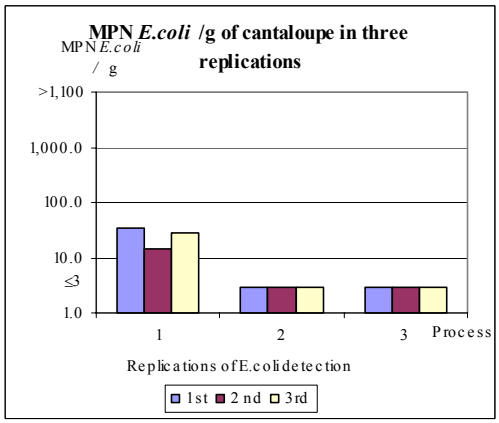

Figure 76 MPN *E.coli* /g with three replications in each step of cantaloupe preparation.

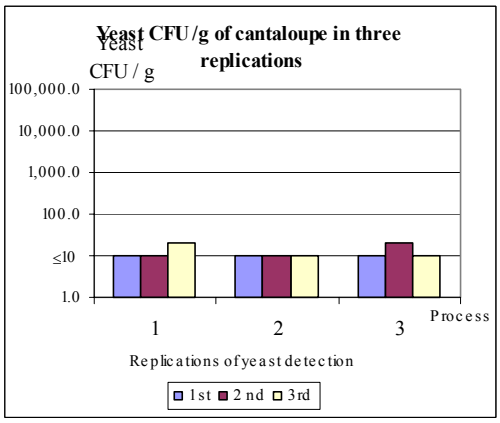

Figure 77 Yeast, CFU /g with three replications in each step of cantaloupe preparation.

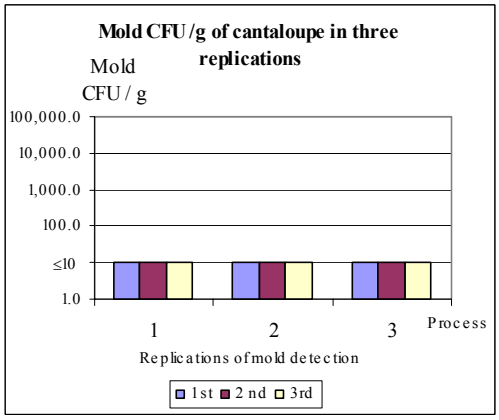

Figure 78 Mold, CFU /g with three replications in each step of cantaloupe preparation.

The data in table 21 were presented by types of microbiological indicators in cantaloupe and also shown in Figure 75, 76, 77 and 78.

Preparation steps

Figure 75 showed the number of MPN coliform /g in three replications. In the first replication, it was more than 1,100 in step 1, then decreased rapidly to less than 3 in step 2. In the second replication, it was 210 in step 1 and then decreased sharply to

21 in step 2. For the third replication, it was 1,100 in step 1 then decreased rapidly to 26 in step 2.

Figure 76 showed the number of MPN *E.coli*/g in three replications. In the first replication, it was 35 in step 1 and then decreased slightly to less than 3 in step 2. In the second and the third replication, the trend of the growth was quite the same as in the first replication excepted in step 1. It was 14 in the second replication while it was 28 in the third replication.

Figure 77 showed the number of yeast in three replications. In the first replication it was 10 CFU /g in step 1 then decreased slightly to less than 10 CFU /g in step 2. In the second replication it was 10 CFU /g in step 1 then decreased slightly to less than 10 CFU /g in step 2. For the third replication the pattern of the number was same as in the first replication. It was 20 CFU /g in step 1 next decreased slightly to less than 10 CFU /g in step 3.

Figure 78 showed the number of yeast CFU /g in three replications. It was less than 10 CFU /g in each step of three replications.

For pathogenic organisms the number of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* was not detected in all steps of three replications.

Time of salad displaying

According to table 21 and figure 75,76,77 and 78 the microbiological quality of salad first displaying and after display 2 hrs but not more than 3 hrs of display showed that the number of MPN coliform /g increased from less than 3 to 9.3, 21.0 to 240.0 and 26.0 to 460.0 in the first, the second and the third replication respectively. The number of MPN *E.coli* /g was less than 3 in both first displaying and after display 2 hrs but not more than 3 hrs of display of three replications. The number of yeast CFU /g was less than 10 CFU /g in both first displaying and after display 2 hrs but not more than 3 hrs of display of both the first and the third replication whereas, it increased from less than 10 to 20 CFU /g in the second replication. The number of mold CFU /g was less than 10 CFU /g in both first displaying and after display 2 hrs but not more than 3 hrs of display of three replications.

For pathogenic organisms the number of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* was not detected in all steps of three replications.

Red cabbage

Table 21 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of red cabbage preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	15	29.0	21.0	<3	3.0	<3	$5.0x10^4$	$3.0x10^4$	$4.0x10^4$	30	30	20
2	9.1	28.0	15.0	<3	<3	<3	$4.0x10^4$	$1.0x10^4$	$2.0x10^4$	30	20	10
3	150	21.0	150.0	<3	<3	<3	170	130	100	20	20	<10
4	44	36.0	210.0	<3	<3	<3	100	60	40	<10	<10	<10
5	210	290.0	210.0	<3	<3	<3	200	100	120	10	10	20

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→ slicing→ keeping in fridge→ cleaning → displaying → after displaying 2 hrs

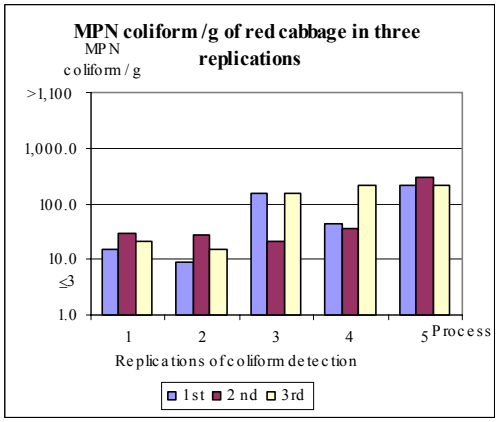

Figure 79 MPN coliform /g with three replications in each step of red cabbage preparation.

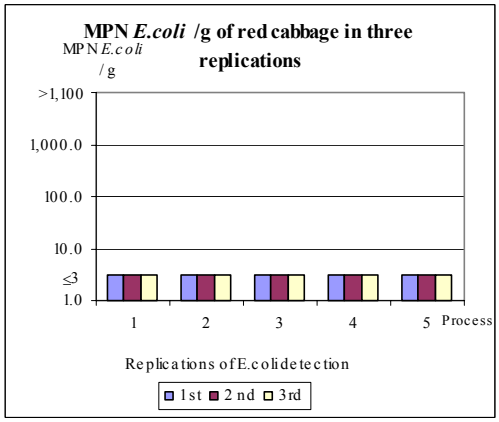

Figure 80 MPN *E.coli* /g with three replications in each step of red cabbage preparation.

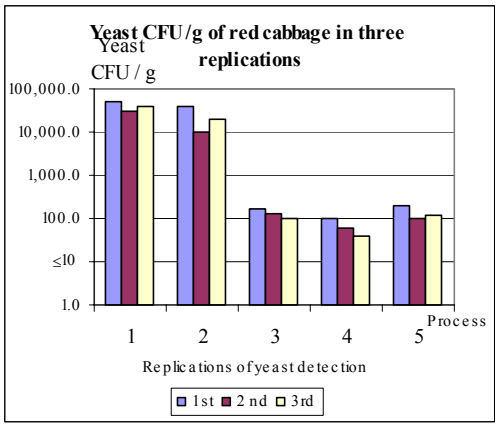

Figure 81 Yeast, CFU /g with three replications in each step of red cabbage preparation.

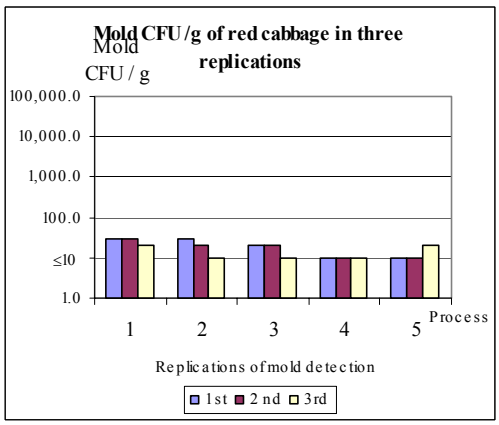

Figure 82 Mold, CFU /g with three replications in each step of red cabbage preparation.

The data in table 22 were presented by types of microbiological indicators in red cabbage and also shown in Figure 79, 80, 81 and 82.

Preparation steps

Figure 79 showed the number of MPN coliform /g in three replications. In the first replication, it was 15 in step 1, then decreased slightly to 9.1 in step 2 and still increased to 150 in step 3. In contrast, it decreased sharply to 44 in step 4. In the second replication, it was 29 in step 1, then decreased slightly to 28 and 21 in step 2 and 3 respectively. However it increased slightly to 36 in step 4. For the third replication, it was 21 in step 1, next decreased slightly to 15 in step 2. On the other hand, it increased sharply to 150 in step 3 and still increased to 210 in step.

Figure 80 showed the number of MPN *E.coli* /g in three replications. It was less than 3 in each step of both the first and the third replications. For the second replication, it was 3 in step 1, then decreased slightly to less than 3 in step 2 to step 4.

Figure 81 showed the number of yeast CFU /g in three replications. In the first replication, it was 5.4 x 10^4 CFU /g in step 1, then decreased slightly to 4.0 x 10^4 CFU /g in step 2. After that it decreased rapidly to 170 and 100 CFU /g in step 3 and 4 respectively. In the second replication, it was 3.1 x 10^4 CFU /g in step 1, next decreased slightly to 1.0 x 10^4 CFU /g in step 2. Then it decreased sharply to 130 and

60 CFU /g in step 3 and 4 respectively. For the third replication, it was 4.0 x 10^4 CFU /g in step 1, then decreased slightly to 2.0 x 10^4 CFU /g in step 2. After that it decreased rapidly to 100 and 40 CFU /g in step 3 and 4 respectively.

Figure 82 showed the number of mold CFU /g in three replications. In the first replication, it was 30 CFU /g in both step 1 and step 2, then decreased slightly to 20 and less than 10 CFU /g in step 3 and 4 respectively. In the second replication, it was 30 CFU /g in step 1, then decreased slightly to 20 CFU /g in both step 2 and step 3 and still decreased to less than 10 CFU /g in step 4. For the third replication, it was 20 CFU /g in step 1, next decreased slightly to 10 CFU /g in step 2 and continued decreasing to less than 10 CFU /g in both step 3 and step 4.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in each step of three replications.

Time of salad displaying

According to table 22 and figure 79,80,81 and 82 the microbiological quality of salad first displaying and after display 2 hrs but not more than 3 hrs of display showed that the number of MPN coliform /g increased from 44.0 to 210.0, 36.0 to 290.0 in both the first and the second replication but for the third replication, it was 210 in both first displaying and after 2 hrs but not more than 3 hrs of display. The number of MPN *E.coli* /g was less than 3 in both first displaying and after display 2 hrs but not more than 3 hrs of display of three replications. The number of yeast CFU /g increased from 100 to 200, 60 to 100 and 40 to 120 CFU /g in the first, the second and the third replication respectively. The number of mold CFU /g increased from less than 10 to 10 CFU /g in both the first and the second replication and increased to 20 CFU /g in the third replication.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in each step of three replications.

Cabbage

Table 22 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of cabbage preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	<3	23.0	3.0	<3	<3	<3	$1.8x10^5$	$1.0x10^5$	$1.2x10^5$	40	80	20
2	3.6	15.0	3.0	<3	<3	<3	$1.5x10^5$	$8.0x10^4$	$1.0x10^5$	20	100	10
3	<3	9.2	150.0	<3	<3	<3	180	300	300	10	50	<10
4	<3	<3	29.0	<3	<3	<3	150	300	200	20	<10	10
5	15	28.0	15.0	<3	<3	<3	210	350	230	30	10	10

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→ slicing→ keeping in fridge → cleaning → displaying → after displaying 2 hrs

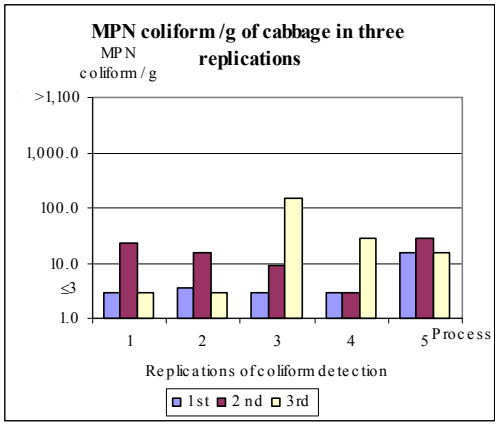

Figure 83 MPN coliform /g with three replications in each step of cabbage preparation.

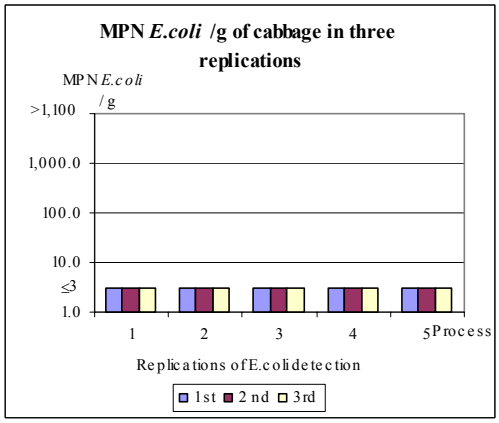

Figure 84 MPN *E.coli* /g with three replications in each step of cabbage preparation.

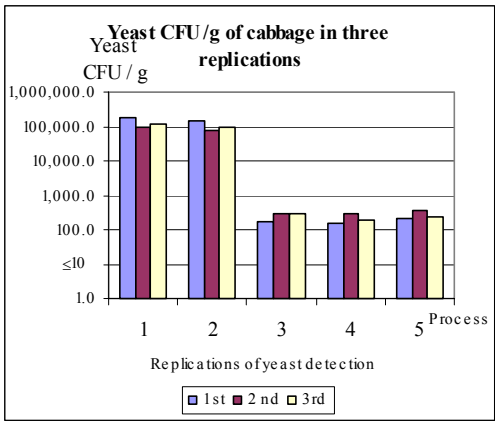

Figure 85 Yeast, CFU /g with three replications in each step of cabbage preparation.

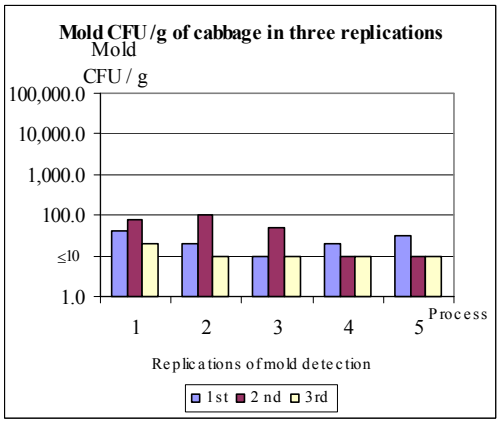

Figure 86 Mold, CFU /g with three replications in each step of cabbage preparation.

The data in table 23 were presented by types of microbiological indicators in cabbage and also shown in Figure 83, 84, 85 and 86.

Preparation steps

Figure 83 showed the number of MPN coliform /g in three replications. In the first replication, it was less than 3 in step 1, then increased slightly to 3.6 in step 2. After that it decreased slightly to less than 3 again in both step 3 and step 4. In the second replication, it was 23 in step 1, then decreased to 15, 9.2 and less than 3 in step 2, 3 and 4 respectively. For the third replication, it was 3 in both steps 1 and 2, next increased rapidly to 150 in step 3. In contrast, it decreased sharply to 29 in step 4 respectively.

Figure 84 showed the number of MPN *E.coli* /g in three replications. It was less than 3 in all steps of three replications.

Figure 85 showed the number of yeast CFU /g in three replications. In the first replication, it was 1.8 x 10^5 CFU /g in step 1, then decreased slightly to 1.5 x 10^5 CFU /g in step 2. After that it decreased rapidly to 180 and 150 CFU /g in step 3 and 4 respectively. In the second replication, it was 1.0 x 10^5 CFU /g in step 1, next decreased slightly to 8.0 x 10^4 CFU /g in step 2, then decreased sharply to 300 CFU /g in step 3 and step 4. For the third replication, it was 1.2 x 10^5 CFU /g in step 1, then

decreased slightly to 1.0 x 10^5 CFU /g and continued rapidly decreasing to 300 and 200 CFU /g in step 3 and 4 respectively.

Figure 86 showed the number of mold CFU /g in three replications. In the first replication, it was 40 CFU /g in step 1, then decreased slightly to 20 and 10 CFU /g in step 2 and 3 respectively. However it increased slightly to 20 CFU /g in step 4. In the second replication, it was 80 CFU /g in step 1, then increased slightly to 100 CFU /g in step 2. After that it decreased sharply to 50 and less than 10 CFU /g in step 3 and 4 respectively. For the third replication, it was 20 CFU /g in step 1 and then decreased slightly to 10 and less than 10 CFU /g in step 2 and 3 respectively. After that it increased to 10 CFU /g again in steps 4.

For pathogenic organisms the number of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* was not detected in all steps of three replications.

Time of salad displaying

According to table 23 and figure 83,84,85 and 86 the microbiological quality of salad first displaying and after display 2 hrs but not more than 3 hrs of display showed that the number of MPN coliform /g increased from less than 3 to 15 and 28 in the first and the second replication respectively whereas, it decreased from 29 to 15 in the third replication. The number of MPN *E.coli* /g was less than3 in both first displaying and after 2 hrs but not more than 3 hrs of display of three replications. The number of yeast CFU /g increased from150 to 210, 300 to 350 and200 to 230 CFU /g in the first, the second and the third replication respectively. The number of mold CFU /g increased from 20 to 30 and less than 10 to 10 in the first and the second replication respectively while, it was 10 CFU /g of first displaying and after 2 hrs but not more than 3 hrs of display of the third replication.

For pathogenic organisms the number of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* was not detected in all steps of three replications.

Carrot

Table 23 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of carrot preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	23.0	15.0	15.0	<3	<3	<3	$5.7x10^4$	$4.5x10^3$	$4.0x10^3$	20	50	20
2	3.6	7.4	3.6	<3	<3	<3	$1.1 x10^5$	$1.5 x10^5$	$1.0 x10^5$	10	20	10
3	3.6	3.0	3.0	<3	<3	<3	$6.0 x10^3$	$5.0 x10^3$	$3.0 x10^3$	20	<10	<10
4	15.0	20.0	11.0	<3	<3	<3	150	800	400	<10	<10	100
5	75.0	120.0	28.0	<3	<3	<3	$1.2 x10^3$	$1.0 x10^3$	900	<10	100	100

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→ Peeling and cutting → keeping in fridge → cleaning → displaying

❺

→ after displaying 2 hrs

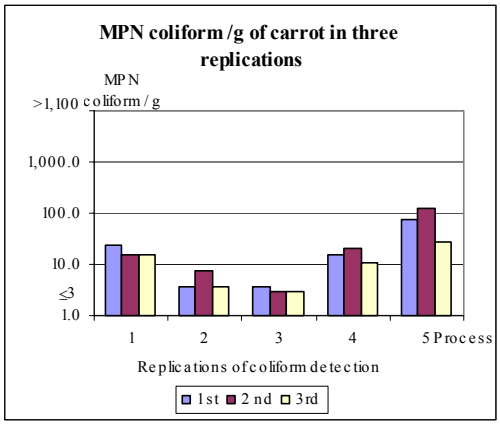

Figure 87 MPN coliform /g with three replications in each step of carrot preparation.

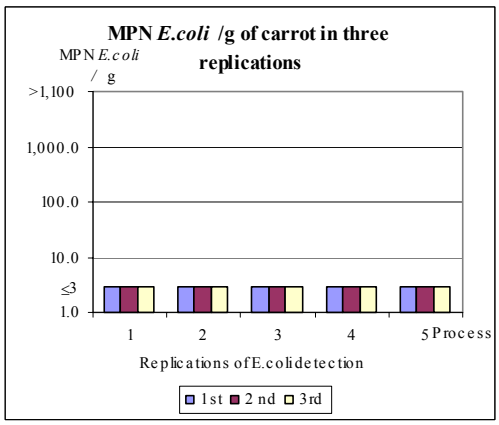

Figure 88 MPN *E.coli* /g with three replications in each step of carrot preparation.

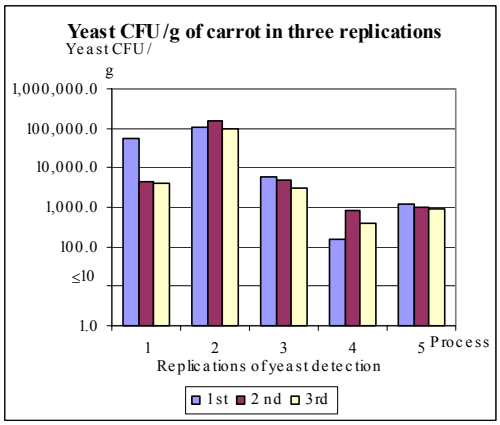

Figure 89 Yeast, CFU /g with three replications in each step of carrot preparation.

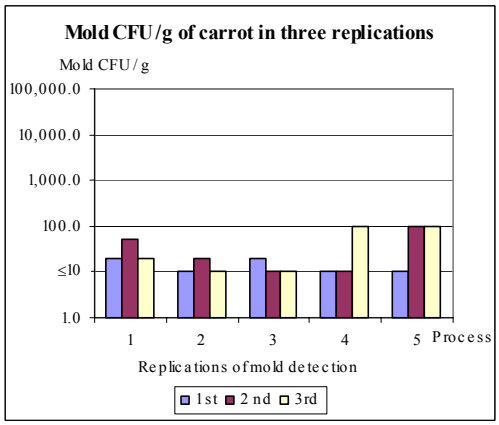

Figure 90 Mold, CFU /g with three replications in each step of carrot preparation.

The data in table 24 were presented by types of microbiological indicators in carrot and also shown in Figure 82, 83, 84 and 85.

Preparation steps

Figure 87 showed the number of MPN coliform /g in three replications. In the first replication, it was 23 in step 1, then decreased slightly to 3.6 in step 2 and 3. After that it increased slightly to 15 in step 4. In the second replication, it was 15 in step 1 and then decreased slightly to 7.4 and 3.0 in step 2 and 3 respectively. After that it increased slightly to 20 in step 4. For the third replication, it was 15 in step 1, then decreased slightly to 3.6 and 3.0 in step 2 and 3 respectively. Whereas it increased slightly to 11 in step 4.

Figure 88 showed the number of MPN *E.coli* /g in three replications. It was less than 3 in all steps of three replications.

Figure 89 showed the number of yeast CFU /g in three replications. In the first replication, it was 5.7 x 10^4 CFU /g in step 1, then increased sharply to 1.1 x 10^5 CFU /g in step 2. In contrast, it decreased rapidly to 6.0 x 10^3 and 150 CFU /g in step 3 and 4 respectively. In the second replication, it was 4.5 x 10^3 CFU /g in step 1 and then increased rapidly to 1.5 x 10^5 CFU /g in step 2. However it decreased sharply to 5.0 x 10^3 and 800 CFU /g in step 3 and 4 respectively. For the third replication it was 4.0 x

10^3 CFU /g in step 1, then increased rapidly to 1.0 x 10^5 CFU /g in step 2. After that it decreased sharply to 3.0 x 10^3 and 400 CFU /g in step 3 and 4 respectively.

Figure 90 showed the number of mold CFU /g in three replications. In the first replication, it was 20 CFU /g in step 1 and then decreased slightly to 10 CFU /g in step 2. On the other hand it increased slightly to 20 CFU /g again in step 3. Finally it decreased slightly to less than 10 CFU /g in step 4. For the second replication it was 50 CFU /g in step 1, then decreased slightly to 20 CFU /g in step 2 and still decreased to less than 10 CFU /g in both step 3 and step 4. In the third replication, it was 20 CFU /g in step 1, then decreased slightly to 10 and less than 10 CFU /g in step 2 and 3 respectively. Finally it increased sharply to 100 CFU /g in step 4.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in each step of three replications.

Time of salad displaying

According to table 23 and figure 87,88,89 and 90 the microbiological quality of salad first displaying and after display 2 hrs but not more than 3 hrs of display showed that the number of MPN coliform /g increased from 15.0 to 75.0, 20.0 to 120.0 and 11.0 to 28.0 in the first, the second and the third replication respectively. The MPN *E.coli* /g was less than 3 in both first displaying and after display 2 hrs but not more than 3 hrs of display of three replications. The number of yeast CFU /g increased from150 to 1.0x103, 800 to 1.0x103 and 400 to900 CFU /g in the first, the second and the third replication respectively. The number of mold CFU /g was less than 10 in both first displaying and after display 2 hrs but not more than 3 hrs of display of the first replication while, it was 100 CFU /g in the third replication. It increased from less than 10 to 100 CFU /g in the third replication.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in each step of three replications.

Baby corn

Table 24 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of baby corn preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	>1,100	210.0	1,100	3.6	7.2	3.6	$3.2x10^3$	$2.0x10^3$	$2.7x10^3$	<10	20	10
2	>1,100	1,100.0	1,100	11.0	3.6	7.3	$4.7x10^3$	$3.0x10^3$	$3.5x10^3$	<10	<10	<10
3	<3	<3	<3	<3	<3	<3	<10	<10	15	<10	<10	<10
4	<3	<3	<3	<3	<3	<3	<10	<10	10	<10	<10	<10
5	<3	<3	<3	<3	<3	<3	<10	10	10	<10	<10	<10

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→ Cutting → boiling → putting in water → dewatering → displaying

❺

→ After displaying 2 hrs

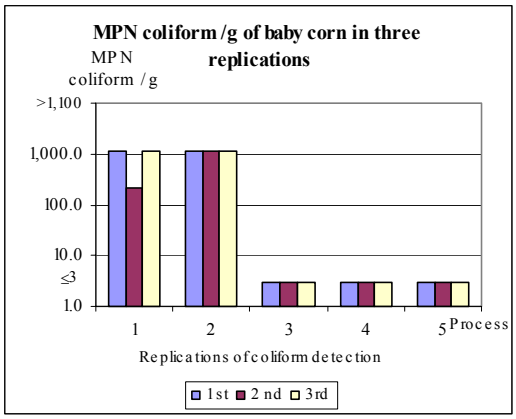


Figure 91 MPN coliform /g with three replications in each step of baby corn preparation.

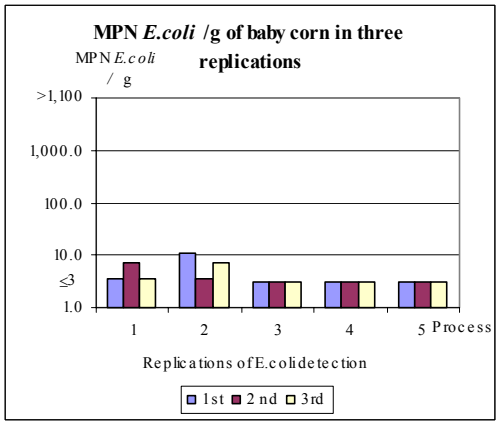


Figure 92 MPN *E.coli* /g with three replications in each step of baby corn preparation.

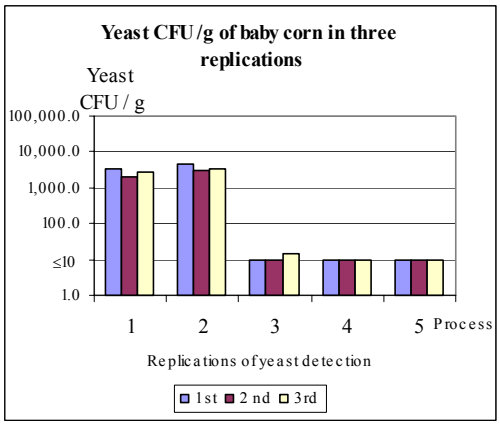


Figure 93 Yeast, CFU /g with three replications in each step of baby corn preparation.

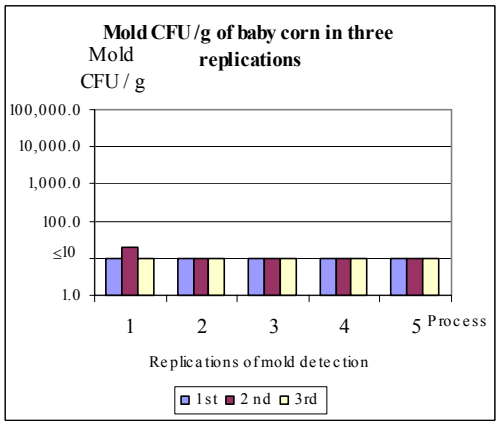


Figure 94 Mold, CFU /g with three replications in each step of baby corn preparation.

The data in table 25 were presented by types of microbiological indicators in baby corn and also shown in Figure 91, 92, 93 and 94

Preparation steps

Figure 91 showed the number of MPN coliform /g in three replications. In the first replication, it was more than 1,100 in both step 1 and step 2 after that decreased rapidly to less than 3 in step 3 and 4. In the second replication, it was 210 in step 1 and then increased sharply to 1,100 in step 2. In contrast, it decreased rapidly to less than 3 in step 3 and 4. For the third replication, it was 1,100 in both step 1 and step 2 and then decreased rapidly to less than 3 in step 3 and 4.

Figure 92 showed the number of MPN *E.coli* /g in three replications. In the first replication, it was 3.6 in step 1 then increased slightly to 11 in step 2. However, it decreased to less than 3 in step 3 and 4. In the second replication, it was 7.2 in step 1 then decreased slightly to 3.6 in step 2. Finally it continued decreasing to less than 3 in step 3 and 4. In the third replication, it was 3.6 in step 1, then increased slightly to 7.3 in step 2. In contrast it decreased to less than 3 in step 3 and 4.

Figure 93 showed the number of yeast CFU /g in three replications. In the first replication, it was 3.2 $x10^3$ CFU /g in step 1 then increased slightly to 4.7 x 10^3 CFU /g in step 2. Finally the number decreased rapidly to less than 10 in step 3 and 4. In the second replication, it was 2.0 x 10^3 CFU /g in step 1 then increased slightly to 3.0 x

10^3 CFU /g in step 2. After that it decreased sharply to less than 10 in both step 3 and step 4. For the third replication, it was 2.7 x 10^3 CFU /g in step 1 then increased slightly to 3.5 x 10^3 CFU /g in step 2. After that it decreased rapidly to 15 CFU /g in step 3 and continued decreasing to 10 CFU /g in step 4.

Figure 94 showed the number of mold CFU /g in three following replications. In the first replication, it was less than 10 CFU /g in all steps. In the second replication, it was 20 CFU /g in step 1 then decreased to less than 10 CFU /g in step 1 to step 4. In the third replication, it was 10 CFU /g in step 1 and then also decreased to less than 10 CFU /g in step 2 to step 4.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in each step of three replications.

Time of salad displaying

According to table 25 and figure 91,92,93 and 94 the microbiological quality of salad first displaying and after 2 hrs but not more than 3 hrs of display showed that the number of MPN coliform /g was less than 3 in both first displaying and after 2 hrs but not more than 3 hrs of display of three replications. The number of MPN *E.coli* /g was also the same as the number of MPN coliform /g. The number of yeast CFU /g was less than 10 CFU /g in both first displaying and after display 2 hrs but not more than 3 hrs of display of the first replication whereas, it was 10 CFU /g in the third replication. It increased from less than 10 to 10 in the second replication. The number of mold CFU /g was less than 10 CFU /g in both first displaying and after display 2 hrs but not more than 3 hrs of display of three replications.

For pathogenic organisms the number of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* was not detected in any steps of three replications.

Asparagus

Table 25 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of asparagus preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	240	93.0	150.0	93	21.0	43.0	$3.0x10^4$	$2.0x10^4$	$2.4x10^4$	<10	30	20
2	210	210.0	53.0	<3	3.0	<3	$4.2x10^4$	$2.5x10^4$	$3.0x10^4$	<10	<10	<10
3	<3	<3	<3	<3	<3	<3	<10	<10	10	<10	<10	<10
4	<3	<3	<3	<3	<3	<3	<10	200	130	<10	<10	10
5	7.3	7.2	6.1	<3	<3	<3	<10	300	250	<10	20	10

❶ ❷ ❸ ❹

→ Cutting → boiling → putting in water → dewatering → displaying

❺

→ After displaying 2 hrs

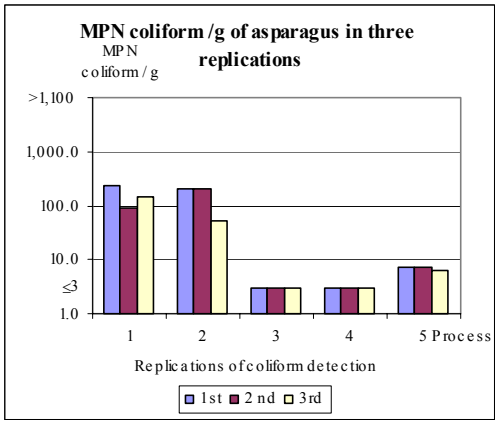


Figure 95 MPN coliform /g with three replications in each step of asparagus preparation.

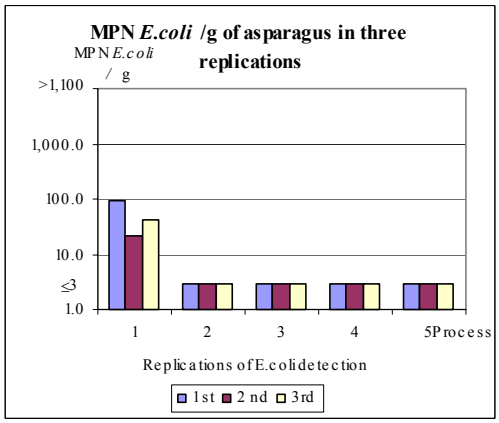


Figure 96 MPN *E.coli* /g with three replications in each step of asparagus preparation.

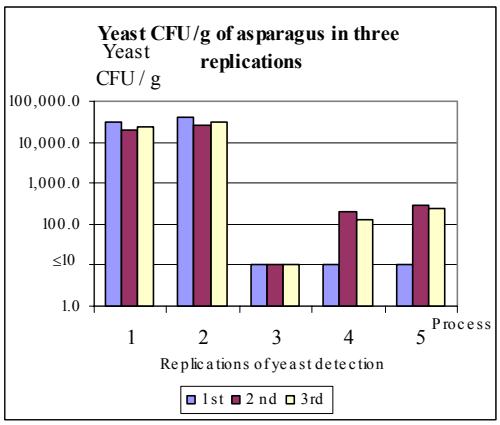


Figure 97 Yeast, CFU /g with three replications in each step of asparagus preparation.

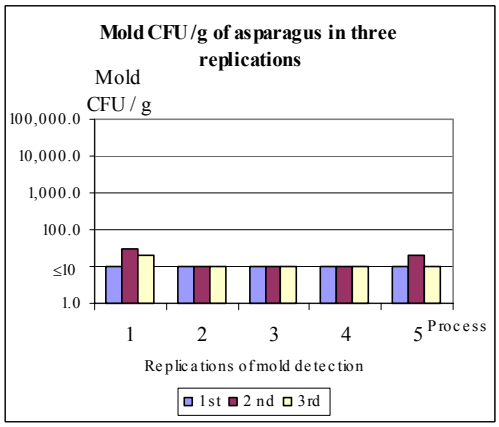


Figure 98 Mold, CFU /g with three replications in each step of asparagus preparation.

The data in table 26 were presented by types of microbiological indicators in asparagus and also shown in Figure 95, 96, 97 and 98

Preparation steps

Figure 95 showed the number of MPN coliform /g in three replications. In the first replication, it was 240 in step 1, then decreased slightly to 210. After that it decreased sharply to less than 3 in both step 3 and step 4. In the second replication, it was 93 in step 1, then increased to 210 in step 2. In contrast, it decreased sharply to less than 3 in both step 3 and step 4. For the third replication, it was 150 in step 1, then decreased to 53 in step 2 and still decreased to less than 3 in both step 3 and step 4.

Figure 96 showed the number of MPN *E.coli* /g in three replications. In the first replication, it was 93 in step 1, then decreased to less than 3 in step 2 to 4. In the second replication, it was 21 in step 1, then decreased to 3 in step 2 and continued decreasing to less than 3 in step 3 and 4. For the third replication, it was 43 in step 1 then decreased to less than 3 in step 2 to 4.

Figure 97 showed the number of yeast CFU /g in three replications. In the first replication, it was 3 x 10^4 CFU /g in step 1, then increased slightly to 4.2 x 10^4 CFU /g in step 2. After that it decreased sharply to less than 10 CFU /g in step 3 and 4. In the second replication, it was 2.0 x 10^4 CFU /g, then increased slightly to 2.5 x 10^4 CFU /g

in step 2. Next it decreased rapidly to less than 10 CFU /g, after that increased sharply to 200 CFU /g in step 4. For the third replication, it was 2.4 x 10^4 CFU /g in step 1, then increased slightly to 3.0 x 10^4 CFU /g in step 2. Next it decreased sharply to 10 CFU g in step 3. However, it increased rapidly to 130 CFU /g in step 4.

Figure 98 showed the number of mold CFU /g in three replications. It was less than10 CFU /g in all steps of the first replication. In the second replication, it was 30 CFU /g in step 1, then decreased slightly to less than 10 CFU /g in step 2, 3 and 4. For the third replication, it was 20 CFU /g in step 1 then decreased slightly to less than 10 CFU /g in both step 2 and step 3. After that it increased slightly to 10 CFU /g in step 4.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in each step of three replications.

Time of salad displaying

According to table 26 and figure 95,96,97 and 98 the microbiological quality of salad first displaying and after 2 hrs but not more than 3 hrs of display showed that the number of MPN coliform /g increased from less than 3 to 7.3, 7.2 and 6.1 in the first, the second and the third replication respectively. The number of MPN *E.coli* /g was less than 3 in both first displaying and after 2 hrs but not more than 3 hrs of display of three replications. The number of yeast CFU /g was less than 10 CFU /g in both first displaying and after 2 hrs but not more than 3 hrs of display of the first replication. It increased from 200 to 300 and 130 to 250 CFU /g in the second and the third replication. The number of mold CFU /g was less than 10 and 10 CFU /g in both first displaying and after 2 hrs but not more than 3 hrs of display of the first and the third replication respectively. It increased from less than 10 to 20 in the second replication.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in all steps of three replications.

Potato

Table 26 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of potato preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	<3	3.6	<3	<3	<3	<3	$1.2x10^4$	$1.0x10^4$	$9.0x10^3$	20	10	30
2	75.0	11.0	39.0	3	3.0	3.0	$3.0 x10^4$	$2.0 x10^4$	$7.0 x10^3$	20	10	20
3	93.0	9.2	21.0	43	<3	21.0	$2.8 x10^3$	$2. x10^3$	900	10	<10	<10
4	7.3	3.0	7.3	3.6	<3	3.6	400	600	200	<10	<10	<10
5	<3	<3	<3	<3	<3	<3	10	<10	10	<10	<10	<10
6	3.6	15.0	3.0	<3	<3	<3	50	40	150	20	20	20

❶ ❷ ❸

→ Peeling → cutting → putting in water→ keeping in fridge → cleaning

❹ ❺ ❻

→ boiling → Displaying → after displaying 2 hrs

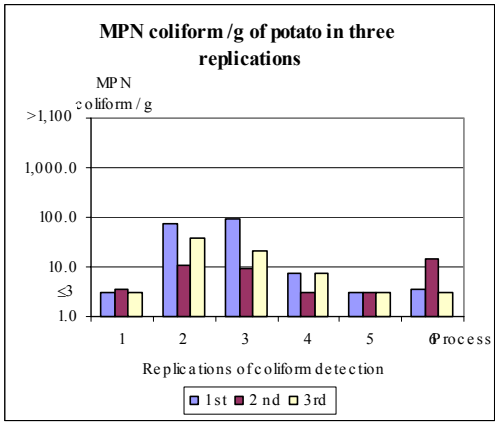


Figure 99 MPN coliform /g with three replications in each step of potato preparation.

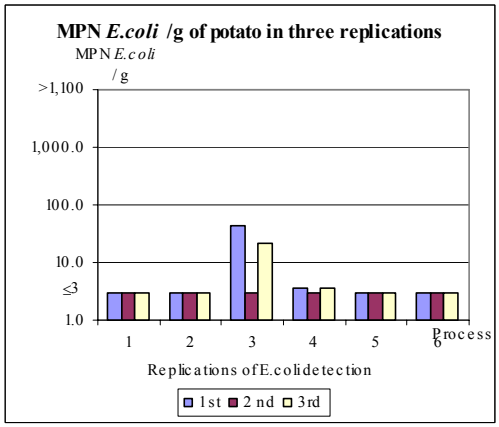


Figure 100 MPN *E.coli* /g with three replications in each step of potato preparation.

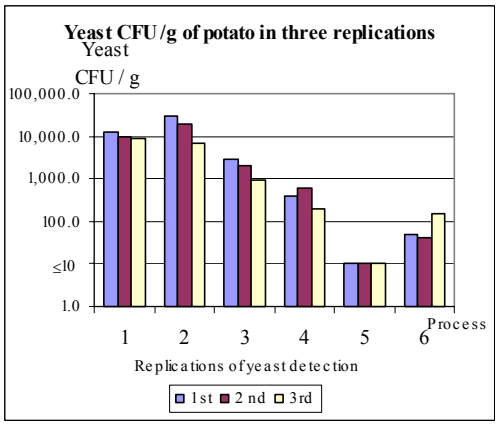


Figure 101 Yeast, CFU /g with three replications in each step of potato preparation.

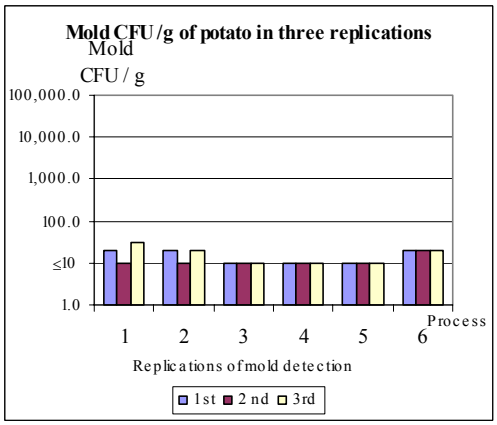


Figure 102 Mold, CFU /g with three replications in each step of potato preparation.

The data in table 27 were presented by types of microbiological indicators in potato and also shown in Figure 99, 100, 101 and 102.

Preparation steps

Figure 99 showed the number of MPN coliform /g in three replications. In the first replication, it was less than 3 in step 1, then increased sharply to 75 and 93 in step 2 and 3 respectively. After that it decreased rapidly to 73 and less than 3 in step 4 and 5 respectively. In the second replication, it was 3.6 in step 1, next increased slightly to 11 in step2 and then decreased slightly to 9.2, 3 and less than 3 in step 3, 4 and 5 respectively. For the third replication, it was less than 3 in step 1 then increased to 39 in step 2. After that it decreased slightly to 21, 7.3 and less than 3 in step 3, 4 and 5 respectively.

Figure 100 showed the number of MPN *E.coli* /g in three following replications. In the first replication, it was less than 3 in step 1, next increased to 3 and 43 in step 2 and 3 respectively. After that it decreased sharply to 3.6 in step 4 and continued decreasing to less than 3 in step 5. In the second replication, it was less than 3 in step 1, then increased slightly to 3 in step 2. After that it decreased slightly to less than 3 again in step 3 to 5. For the third replication, it was less than 3 in step 1, then increased slightly to 3 and 21 in step 2 and 3 respectively. However it decreased slightly to 3.6 in step 4 and still decreased to less than 3 in step 5.

Figure 101 showed the number of yeast CFU /g in three replications. In the first replication, it was 1.2 x 10^4 CFU /g in step 1, next increased slightly to 3.0 x 10^4 CFU /g in step 2 and then decreased slightly to 2.8 x 10^3 CFU /g in step 3. After that it continued sharply decreasing to 400 and 10 CFU /g in step 4 and 5 respectively. In the second replication, it was 1.0 x 10^4 CFU /g in step 1, then increased slightly to 2.0 x 10^4 CFU /g in step 2. After that it decreased sharply to 2.0 x 10^3, 600 and less than 10 in step 3, 4 and 5 respectively. For the third replication, it was 9.0 x 10^3 CFU /g in step 1, then decreased slightly to 7.0 x 10^3 CFU /g and continued decreasing to 900, 200 and 10 CFU /g in step 3, 4 and 5 respectively.

Figure 102 showed the number of mold CFU /g in three replications. In the first replication, it was 20 CFU /g in both step 1 and step 2, then decreased slightly to10 CFU /g in step 3 and still decreased to less than 10 CFU /g in both step 4 and step 5. In the second replication, it was 10 CFU /g in both step 1 and step 2, then decreased slightly to less than 10 CFU /g in step 3, 4 and 5. For the third replication, it was 30 CFU /g in step 1, then decreased slightly to 20 CFU /g in step 2 and less than 10 CFU /g in step 3, 4 and 5.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in each step of three replications.

Time of salad displaying

According to table 27 and figure 99,100,101 and 102 the microbiological quality of salad first displaying and after 2 hrs but not more than 3 hrs of display showed that the number of MPN coliform/g increased from less than 3 to 3.6,15.0 and 3.0 in the first, the second and the third replication respectively. The number of MPN *E.coli* /g was less than 3 in both first displaying and after 2 hrs but not more than 3 hrs of display of three replications. The number of yeast CFU /g increased from 10 to 50, less than 10 to 40 and 10 to 150 CFU /g in the first, the second and the third replication respectively. The number of mold CFU /g increased from less than 10 to 20 in both first displaying and after 2 hrs but not more than 3 hrs of display of three replications.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in all steps of three replications.

Taro

Table 27 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of taro preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	>1,100	290.0	210.0	23	43.0	9.1	$5.0x10^4$	$2.0x10^4$	$3.2x10^4$	<10	<10	10
2	9.1	15.0	7.3	<3	<3	<3	$4.0 x10^4$	$1.3 x10^4$	$2.0 x10^4$	<10	<10	<10
3	>1,100	1,100.0	290.0	<3	<3	<3	$4.0 x10^3$	$1.2 x10^3$	$1.5 x10^3$	<10	<10	<10
4	<3	<3	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10
5	3.6	6.1	7.3	<3	<3	<3	20	20	<10	<10	<10	<10

❶ ❷ ❸ ❹

→ Peeling→ cutting → putting in water→ boiling → displaying

❺

→ After displaying 2 hrs

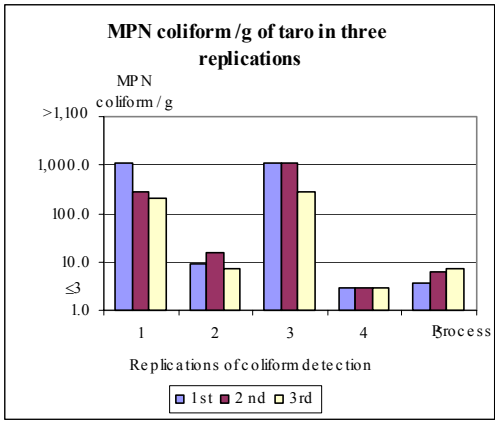


Figure 103 MPN coliform /g with three replications in each step of taro preparation.

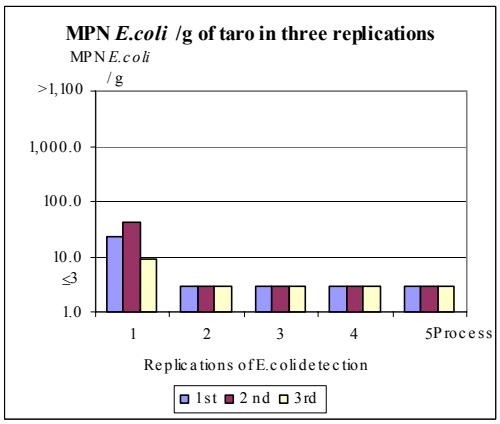


Figure 104 MPN *E.coli* /g with three replications in each step of taro preparation.

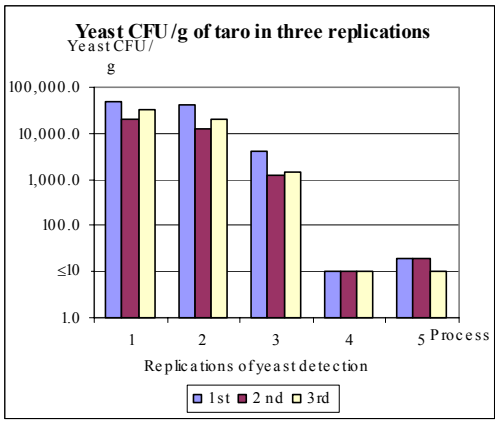


Figure 105 Yeast, CFU /g with three replications in each step of taro preparation.

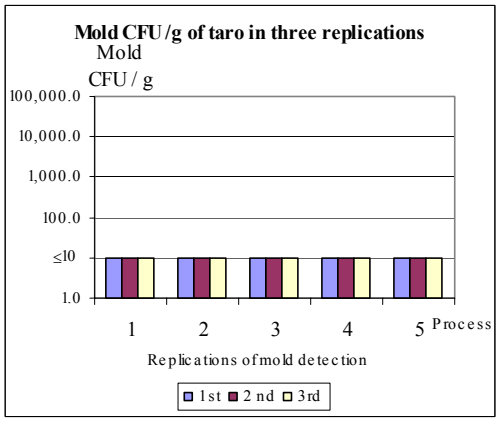


Figure 106 Mold, CFU /g with three replications in each step of taro preparation.

The data in table 28 were presented by types of microbiological indicators in taro and also shown in Figure 103, 104, 105 and 106.

Preparation steps

Figure 103 showed the number of MPN coliform /g in three replications. In the first replication, it was more than 1,100 in step 1, then decreased rapidly to 9.1 in step 2. After that it increased sharply to more than 1,100 again in step 3, whereas decreased rapidly to less than 3 in step 4. In the second replication, it was 290 in step 1, then decreased sharply to 15 in step 2. However it increased rapidly to 1,100 in step 3, next decreased sharply to less than 3 in step 4. For the third replication, it was 210 in step 1 and then decreased sharply to 7.3 in step 2. On the other hand, it increased rapidly to 290 in step 3, next decreased sharply to less than 3 in step 4.

Figure 104 showed the number of MPN *E.coli* /g in three replications. In the first replication, it was 23 in step 1 and then decreased slightly to less than 3 in step 2 to 4. The pattern of the number in the second and the third replications were the same as in the first replication excepted in step 1 of both the second and the third replications which were 4.3 and 9.1 respectively.

Figure 105 showed the number of yeast CFU /g in three replications. In the first replication, it was 5.0×10^4 CFU /g in step 1, then decreased slightly to4.0×10^4 CFU /g in step 2. After that it decreased rapidly to 4.0×10^3 CFU /g and less than 10

CFU /g in step 3 and 4 respectively. In the second replication, it was 2.0 x 10^4 CFU /g in step 1 and then decreased slightly to 1.3 x 10^4 CFU /g in step 2. After that it decreased sharply to 1.2 x 10^3 in step 3 and continued decreasing to less than 10 CFU /g in step 4. In the third replication, it was 3.2 x 10^4 CFU /g in step 1, then decreased slightly to 2.0 x 10^4 CFU /g in step 2. After that it decreased rapidly to 1.5 x 10^3 CFU /g in step 3 and still decreased to less than 10 CFU /g in step 4.

Figure 106 showed the number of mold CFU /g in three replications. It was less than 10 CFU /g in each step of both the first and the second replications. For the third replication it was 10 CFU /g in step 1 and then decreased slightly to less than 10 CFU /g in step 2 to 4.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in each step of three replications.

Time of salad displaying

According to table 28 and figure 103,104,105 and 106 the microbiological quality of salad first displaying and after 2 hrs but not more than 3 hrs of display showed that the number of MPN coliform /g increased from less than 3 to 3.6, 6.1 and 7.3 in the first, the second and the third replication respectively. The number of MPN *E.coli* /g was less than 3 in both first displaying and after 2 hrs but not more than 3 hrs of display of three replications. The number of yeast CFU /g increased from less than 10m to 20 CFU /g in the first replication while it was less than 10 CFU /g in both the second and the third replication. The number of mold CFU /g was less than 10 CFU /g in both first displaying and after 2 hrs but not more than 3 hrs of display of three replications.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in each step of all replications.

Pumpkin

Table 28 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of pumpkin preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	>1,100	210.0	1,100.0	<3	<3	<3	$4.8x10^4$	$3.0x10^4$	$3.5x10^4$	20	20	20
2	23.0	15.0	15.0	<3	<3	<3	$1.0 x10^3$	750	550	10	<10	<10
3	9.1	7.4	9.1	<3	<3	<3	$5.0 x10^3$	$1x10^3$	750	<10	<10	<10
4	<3	<3	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10
5	9.1	<3	9.1	<3	<3	<3	20	<10	<10	<10	<10	<10

❶ ❷ ❸ ❹

→ Peeling and cutting → keeping in fridge → boiling → displaying

❺

→ After displaying 2 hrs

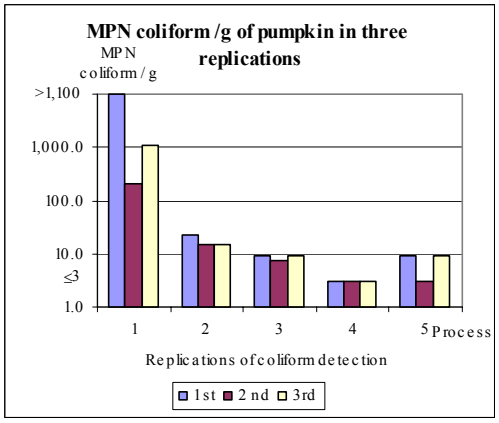


Figure 107 MPN coliform /g with three replications in each step of pumpkin preparation.

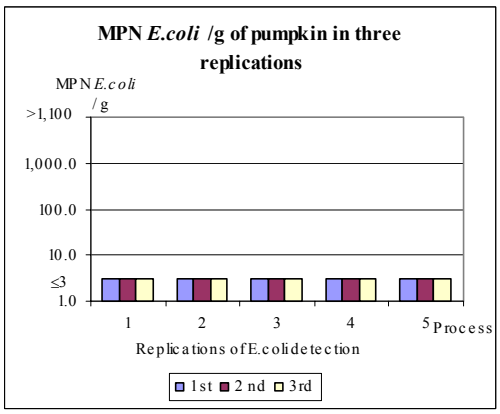


Figure 108 MPN *E.coli* /g with three replications in each step of pumpkin preparation.

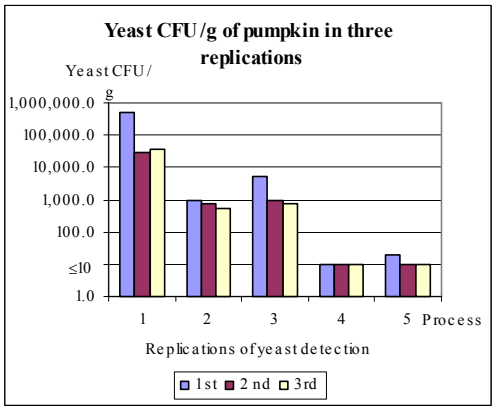


Figure 109 Yeast, CFU /g with three replications in each step of pumpkin preparation.

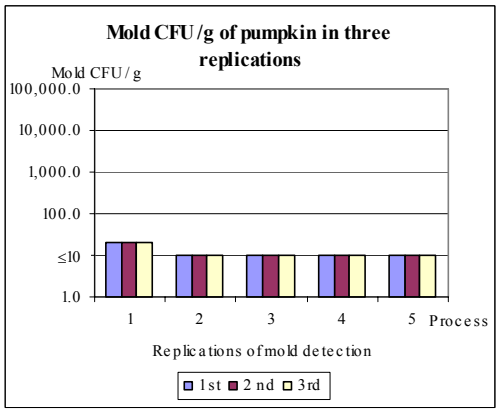


Figure 110 Mold, CFU /g with three replications in each step of pumpkin preparation.

The data in table 29 were presented by types of microbiological indicators in pumpkin and also shown in Figure 107, 108, 109 and 110.

Preparation steps

Figure 107 showed the number of MPN coliform /g in three replications. In the first replication, it was more than 1,100 in step 1, then extremely decreased to 23 in step 2 and still decreased to 9.1 and less than 3 in step 3 and 4 respectively. In the second replication, it was 210 in step 1, then decreased sharply to 15 and 7.4 in step 2 and 3 respectively and continued decreasing to less than 3 in step 4. For the third replication, it was 1,100 in step 1 and then extremely decreased to 15 in step 2 and still decreased to 9.1 and less than 3 in step 3 and 4 respectively.

Figure 108 showed the number of MPN *E.coli* /g in three replications. It was less than 3 in all steps of three replications.

Figure 109 showed the number of yeast CFU /g in three replications. In the first replication, it was 4.8 x 10^4 CFU /g in step 1, then decreased rapidly to 1.0 x 10^3 CFU /g in step 2. After that it increased slightly to 5.0 x 10^3 CFU /g in step 3. However it extremely decreased to less than 10 CFU /g in step 4. In the second replication, it was 3.0 x 10^4 CFU /g in step 1, then extremely decreased to 750 CFU /g in step 2. In contrast it increased sharply to 1.0 x 10^3 CFU /g in step 3. Finally it decreased rapidly to less than 10 CFU /g in step 4. For the third replication it was 3.5 x

10^4 CFU /g in step 1 and then extremely decreased to 550 CFU /g in step 3. Otherwise it increased slightly to 750 CFU /g in step 3. Finally it decreased sharply to less than 10 CFU /g in steps 4.

Figure 110 showed the number of mold CFU /g in three replications. In the first replication, it was 20 CFU /g in step 1 and then decreased slightly to 10 CFU /g in step 2. After that it continued slightly decreasing to less than 10 CFU /g in step 3 and 4. In the second replication, it was 20 CFU /g in step 1, then decreased slightly to less than 10 CFU /g in step 2 to 4. For the third replication, the trend of the number of mold was the same as in the second replication.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in each step of three replications.

Time of salad displaying

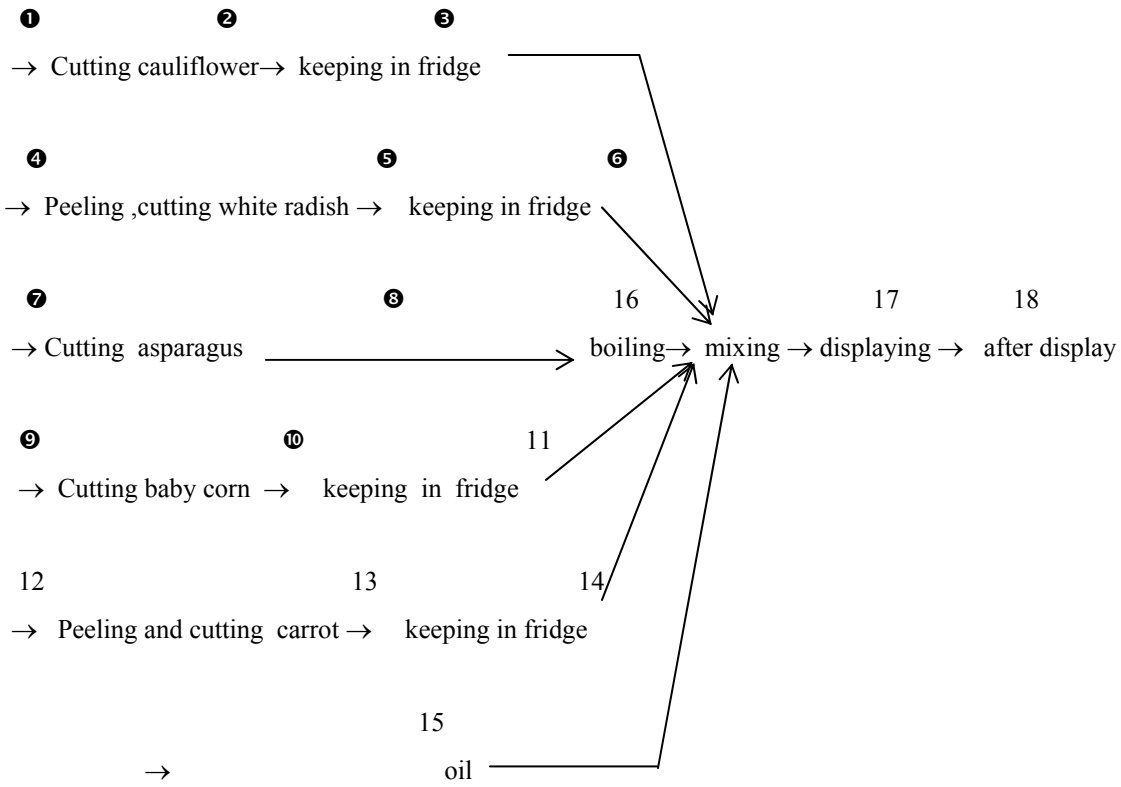
According to table 29 and figure 107,108,109 and 110 the microbiological quality of salad first displaying and after 2 hrs but not more than 3 hrs of display showed that the number of MPN coliform /g increased from less than 3 to 9.1 in both the first and the third replication whereas it was less than 3 in both first displaying and after 2 hrs but not more than 3 hrs of display of the second replication. The number of MPN *E.coli* /g was less than 3 in both first displaying and after 2 hrs but not more than 3 hrs of display of three replications. The number of yeast CFU /g increased from less than 10 to 20 CFU /g in the first replication while it was less than 10 CFU /g in both first displaying and after 2 hrs but not more than 3 hrs of display of both the second and the third replication. The number of mold CFU /g was less than 10 CFU /g in both first displaying and after 2 hrs but not more than 3 hrs of display of three replications.

For pathogenic organisms the number of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* was not detected in all steps of three replications.

Mixed vegetable (cauliflower, white radish, asparagus, baby corn and carrot)

Table 29 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of mixed vegetable preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	>1,100	1,100.0	210.0	<3	<3	<3	$4.5x10^5$	$3.2x10^5$	$4.0x10^5$	$3.0x10^3$	$2.5x10^3$	$2.0x10^3$
2	>1,100	1,100.0	290.0	3	3	<3	$2.0 x10^5$	$1.5 x10^5$	$1.7 x10^5$	$2.0x10^3$	$1.8x10^3$	750
3	1,100.0	210.0	210.0	<3	3	<3	$1.6 x10^5$	$1.0 x10^5$	$1.2 x10^5$	$1.0x10^3$	150	250
4	>1,100	>1,100	1,100.0	3.0	6.1	3.0	$5.2x10^4$	$4.0x10^4$	$4.5x10^4$	$2.0x10^3$	20	$1.5x10^3$
5	460.0	290.0	>1,100	<3	<3	<3	20	20	$3.2x10^3$	<10	<10	<10
6	290.0	36.0	42.0	<3	<3	<3	10	20	$1.2x10^3$	<10	<10	10
7	240	150.0	95.0	<3	<3	9.1	$3.0 x10^4$	$2.8 x10^4$	$3.2 x10^4$	<10	<10	<10
8	210	210.0	1,100.0	<3	<3	<3	$4.2x10^4$	$3.6x10^4$	$4.0x10^4$	<10	<10	<10
9	460.0	290.0	1,100.0	<3	<3	3.0	$3.0 x10^5$	$2.0 x10^5$	$2.7 x10^5$	<10	<10	<10
10	210.0	210.0	1,100.0	<3	<3	11.0	$3.7 x10^5$	$3.0 x10^5$	$4.2 x10^5$	<10	<10	<10
11	290	290.0	210.0	<3	<3	7.2	$2.0x10^4$	$1.2x10^4$	$1.6x10^4$	<10	<10	<10
12	23	38.0	43	<3	<3	<3	$5.7 x10^4$	$5.0 x10^4$	$4.8 x10^4$	100	80	100
13	3.6	7.4	3.6	<3	<3	<3	$4.1 x10^4$	$3.6 x10^4$	$4.0 x10^4$	<10	<10	<10
14	3.6	3.0	7.3	<3	<3	<3	$6.0x10^3$	$4.5x10^3$	$5.0x10^3$	<10	<10	<10
15	<3	<3	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10
16	<3	<3	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10
17	<3	<3	20.0	<3	<3	3.0	<10	<10	150	<10	<10	<10
18	460	210.0	150.0	<3	<3	<3	150	10	270	<10	<10	<10



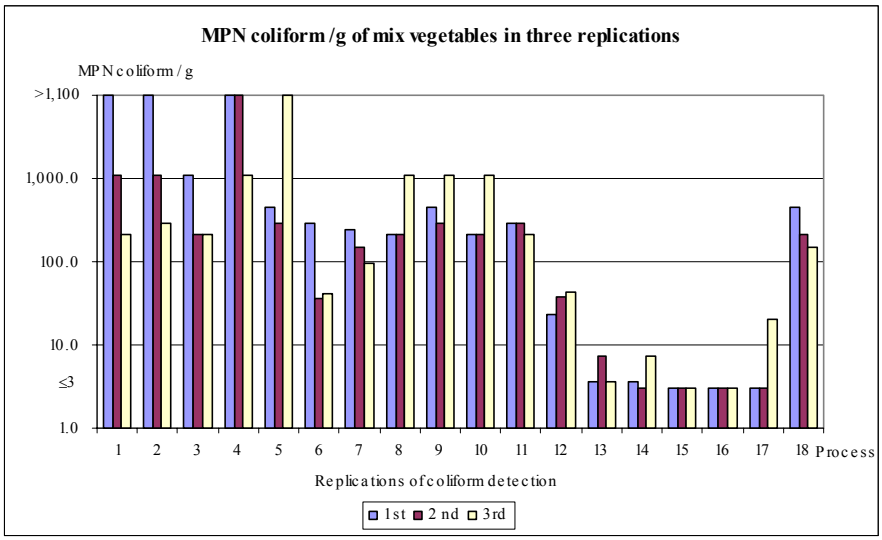


Figure 111 MPN coliform /g with three replications in each step of mixed vegetable preparation.

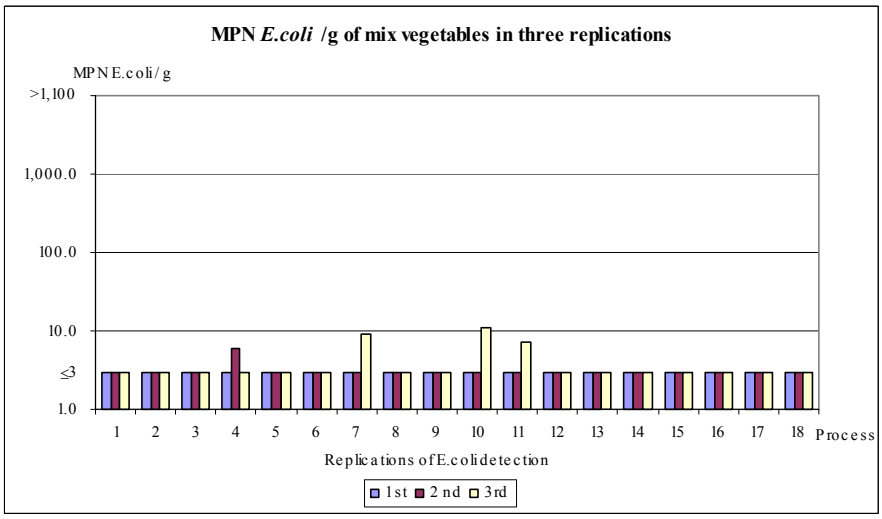


Figure 112 MPN *E.coli* /g with three replications in each step of mixed vegetable preparation.

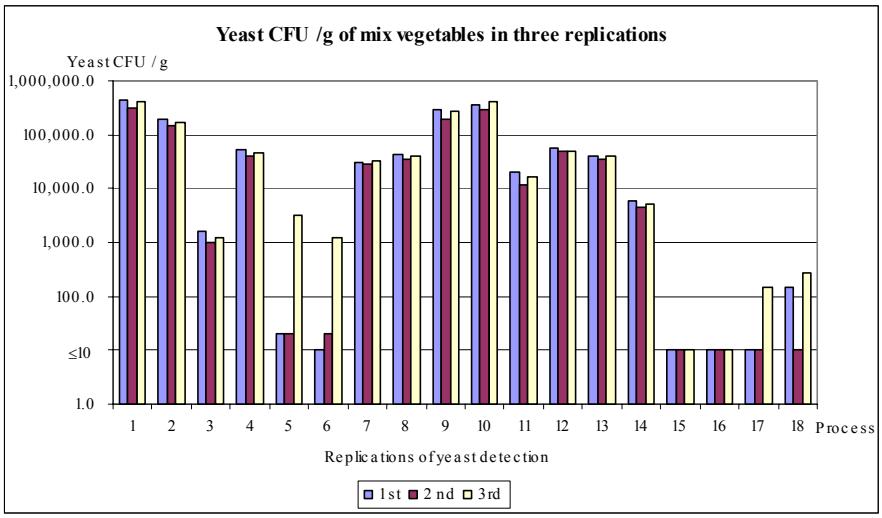


Figure 113 Yeast, CFU /g with three replications in each step of mixed vegetable preparation.

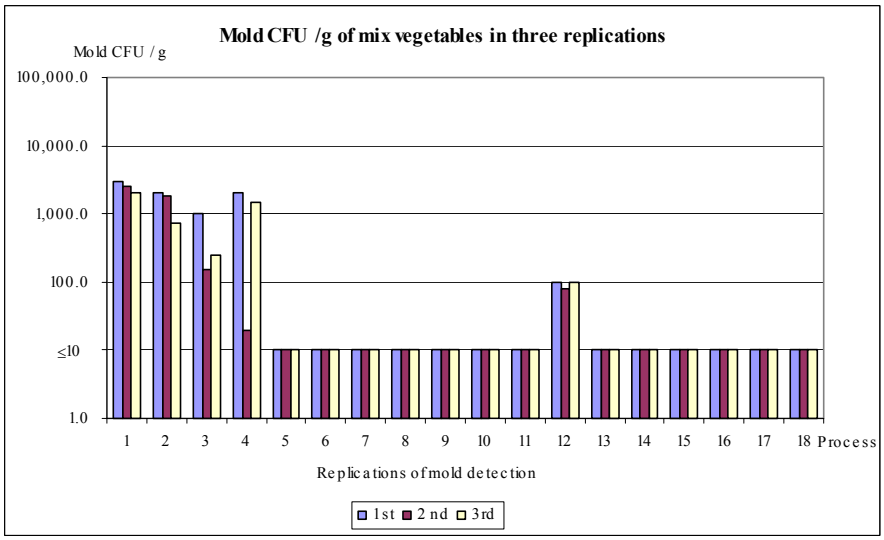


Figure 114 Mold, CFU /g with three replications in each step of mixed vegetable preparation.

The data in table 30 were presented by types of microbiological indicators in mixed vegetables and also shown in Figure 111,112,113 and 114

Preparation steps

The Preparation steps of mixed vegetables were presented into 5 subgroup, cauliflower, white radish, asparagus, baby corn and carrot. Steps of preparing cauliflower were step 1, 2 and 3 and step of preparing white radish were step 4, 5 and 6. Step 7 and 8 were steps of preparing asparagus and step 9, 10 and 11 were steps of preparing baby corn. Step 12, 13 and 14 were steps of preparing carrot. Step 15 was microbiological contamination in oil. Step 16 and 17 were steps of boiling, displaying respectively.

Figure 111 showed the number of MPN coliform /g in three replications. In the first replication it was more than 1,100 in both step 1 and step 2, after that decreased slightly to 1,100 in step 3. It was more than 1,100 in step 4, then decreased to 460 and 290 in step 5 and 6 respectively. Step 7 and 8 were 240 and 210 respectively. It was 460 in step 9, then decreased sharply to 210 in step 10, however in step 11it increased to 290. It was 23 in step 12, then decreased to 3.6 in both step 13 and step 14. Step 15 was coliform bacteria contamination in oil which was less than 3. After that it was less than 3 in step 16 and 17.

In the second replication there was 1,100 in both step 1 and step 2, then decreased rapidly to 210 in step 3. It was more than 1,100 in step 4 and then decreased sharply to 290 and 36 in step 5 and 6 respectively. It was 150 in step 7, next increased slightly to 210 in step 8. It was 290 in step 9 after that decreased slightly to 210. In contrast it increased slightly to 290 again in step 11. In step 12, it was 38, then decreased sharply to 7.4 and 3 in step 13 and 14 respectively. There was less than 3 in step 15, 16 and 17.

In the third replication it was 210 in step 1 then increased slightly to 290 in step 2. After that it decreased slightly to 210 again in step 3. It was 1,100 in step 4 and then increased slightly to more than 1,100 in step 5, next decreased sharply to 42 in step 6. In step 7 it was 95 after that the number increased rapidly to 1,100 in step 8. Then there was 1,100 in both step 9 and step 10 and then decreased sharply to 210 in step 11. In step 12 it was 43, after that decreased to 3.6 in step 13 next increased slightly to 7.3 in step 14. The amount of coliform bacteria contamination in step 15 was less than 3. In step 16 it was less than 3, then increased to 20 in step 17.

Figure 112 showed the number of MPN *E.coli* /g in three replications. In the first replication, it was less than 3 in step 1 then increased slightly to 3 in step 2. After that it decreased sharply to less than 3 again in step 3. It was 3 in step 4, after that decreased slightly to less than 3 in step 5 to 17. In the second replication it was less than 3 in step 1, then increased slightly to 3 in both step 2 and step 3. After that it increased to 6.1 in step 4, finally decreased slightly to less than 3 in step 5 to 17. In the third replication, there was less than 3 in step 1, 2 and 3 then increased slightly to 3 in step 4. In contrast it decreased slightly to less than 3 in both step 5 and step 6.After that it increased to 9.1 in step 7 then decreased to less than 3 again in step 8 however, it increased to 3.0 and 11.0 in step 9 and 10 respectively In step 11 it decreased to 7.2 then continued decreasing to less than 3 in step 12 to 16. Finally it increased to 3.0 in step 17.

Figure 113 showed the number of yeast, CFU /g in three following replications. In the first replication, it was 4.5 x 10^5 CFU /g in step 1 and then decreased slightly to 2.0 x 10^5 CFU /g in step 2 and continued rapidly decreasing to 1.6 x 10^3 CFU /g in step 3. It was 5.2 x 10^4 CFU /g in step 4 then decreased sharply to 20 CFU /g in step 5 and still decreased slightly to 10 CFU /g in step 6. In step 7 it was 3.0 x 10^4 CFU /g then increased slightly to 4.2 x 10^4 CFU /g in step 8. It was 3.0 x 10^5 CFU /g then increased slightly to 3.7 x 10^5 CFU /g in step 10. After that it decreased sharply to 2.0 x 10^4 CFU /g in step 11. It was 5.7 x 10^4 CFU /g in step 12, next decreased slightly to 4.1 x 10^4 CFU /g in step 13 and continued rapidly decreasing to 6.0 x 10^3 CFU /g in step 14. It was less than 10 CFU /g in step 15, 16 and 17

For the second replication, it was 3.2 x 10^5 CFU /g in step 1 then decreased slightly to 1.5 x 10^5 CFU /g in step 2 and continued sharply decreasing to 1.0 x 10^3 CFU /g in step 3. It was 4.0 x 10^4 CFU /g in step 4, after that decreased rapidly to 20 CFU /g in both step 5 and step 6. In step 7, it was 2.8 x 10^4 CFU /g, then increased slightly to 3.6 x 10^4 CFU /g in step 8. it was2.0 x 10^5 CFU /g in step 9 and then increased slightly to 3.0 x 10^5 CFU /g in step 10. Whereas in step 11, it decreased slightly to 1.2 x 10^4 CFU /g. It was 5.0 x 10^4 CU /g in step 12, then decreased slightly to 3.6 x 10^4 CFU /g in step 13 and continued rapidly decreasing to 4.5 x 10^3 CFU /g in step 14. The number of microbiological contamination in oil was less than 10 in step 15. It was less than 10 CFU /g in both step 16 and step 17.

For the third replication, it was 4.0 x 10^5 CFU /g in step 1 then decreased slightly to 1.7 x 10^5 CFU /g in step 2 and continued sharply decreasing to 1.2 x 10^3 CFU /g in step 3. It was 4.5 x 10^4 CFU /g in step 4 then decreased sharply to 3.2 x 10^3 CFU /g in step 5 and continued slightly decreasing to 1.2 x 10^3 CFU /g in step 6. In step 7, it was 3.2 x 10^4 CFU /g, next increased slightly to 4.0 x 10^4 CFU /g in step 8. It was 2.7 x 10^5 CFU /g in step 9 then increased slightly to 4.2 x 10^5 CFU /g in step 10 and still decreased rapidly to 1.6 x 10^4 CFU /g in step 11. It was 4.8 x 10^4 CFU /g in step 12 after that decreased to 4.0 x 10^4 and 5.0 x 103 CFU /g in step 13 and 14 respectively. There was less than 10 in both step 15 and step 16 then increased sharply to 150 CFU /g in step 17.

Figure 114 showed to number of mold, CFU /g in three replications. In the first replication, it was 3.0 x 10^3 CFU /g in step 1 then decreased slightly to 2.0 x 10^3 and 1.0 x 10^3 CFU /g in step 2 and 3 respectively. It was 2.0 x 10^3 CFU /g in step 4 after that decreased sharply to less than 10 CFU /g in step 5 to 11. It was 100 CFU /g in step 12 then decreased rapidly to less than 10 CFU /g again in step 13 to 18. In the second replication, it was 2.5 x 10^3 CFU /g in step 1 then decreased slightly to 1.8 x 10^3 CFU /g in step 2 and continued sharply decreased to 150 CFU /g in step 3. It was 20 CFU /g in step 4 after that decreased slightly to less than 10 CFU /g in step 5 to 11. In step 12 it was 80 CFU /g and decreased to less than 10 in step 13 to 17. In the third replication, it was 2.0 x 10^3 CFU /g in step 1 then decreased sharply to 750 and 250 CFU /g in step 2 and 3 respectively. It was 1.5 x 10^3 CFU /g in step 4 then decreased rapidly to less than 10 CFU /g in step 5, however it increased slightly to 10 CFU /g in step 6. There was less than 10 CFU /g in step 7 to 11. It was 100 CFU /g in step 12 after that decreased rapidly to less than 10 CFU /g in step 13 to 17.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in each step of three replications.

Time of salad displaying

According to table 30 and figure 111,112,113 and 114 the microbiological quality of salad first displaying and after 2 hrs but not more than 3 hrs of display showed that the number of MPN coliform /g increased from less than 3 to 460.0, less

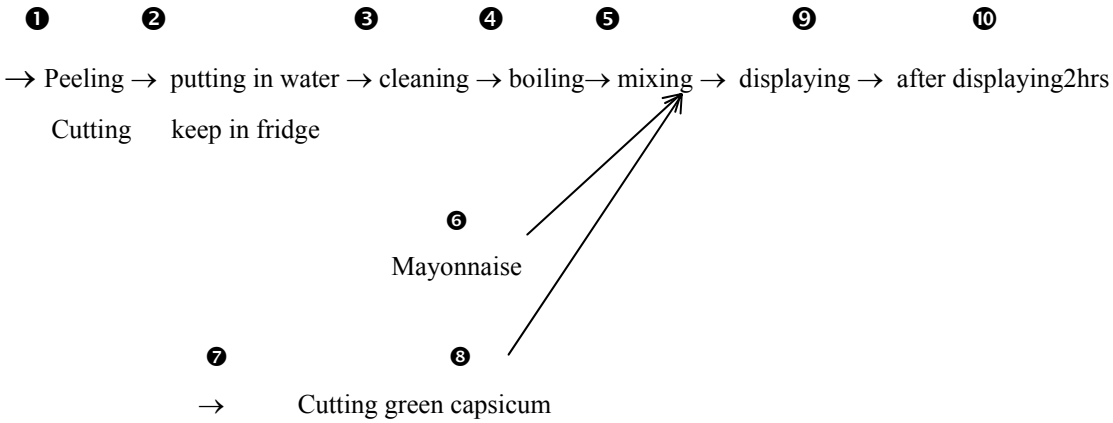
than 3 to 210.0 and 20 to 150.0 in the first, the second and the third replication respectively. The number of MPN *E.coli* /g was less than 3 in both first displaying and after 2 hrs but not more than 3 hrs of display of the first and the second replication in contrast it decreased from 3.o to less than 3 in the third replication. The number of yeast CFU /g increased from less than 10 to 150, less than 10 to 10 and 150 to 270 CFU /g in the first, the second and the third replication respectively. The number of mold CFU /g was less than 3 in both first displaying and after 2 hrs but not more than 3 hrs of display of three replications.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in each step of three replications.

Potato salad

Table 30 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of potato salad preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	<3	3.0	<3	<3	<3	<3	$1.2x10^3$	$1.5x10^3$	$1.0x10^3$	100	200	100
2	75.0	15.0	39.0	3.0	<3	<3	150	650	350	10	20	50
3	93.0	28.0	150.0	43.0	15	15.0	200	120	120	<10	<10	<10
4	7.3	7.4	7.3	3.6	3	3.0	50	100	80	<10	<10	<10
5	<3	<3	<3	<3	<3	<3	<10	<10	0	<10	<10	<10
6	<3	<3	<3	<3	<3	<3	100	90	50	<10	<10	<10
7	<3	<3	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10
8	<3	<3	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10
9	120.0	24.0	120	<3	<3	<3	250	$3x10^3$	550	20	10	<10
10	460.0	210.0	95.0	<3	<3	<3	$3x10^3$	$4x10^4$	$1x10^3$	30	20	10



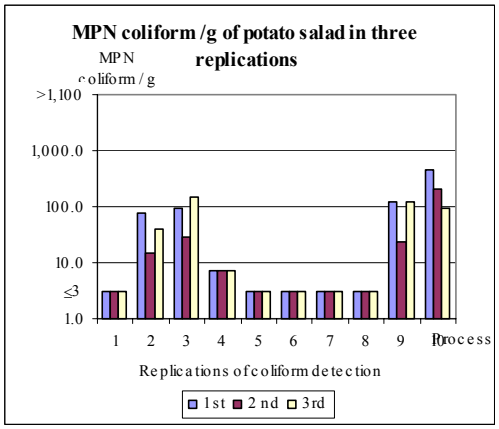


Figure 115 MPN coliform /g with three replications in each step of potato salad preparation.

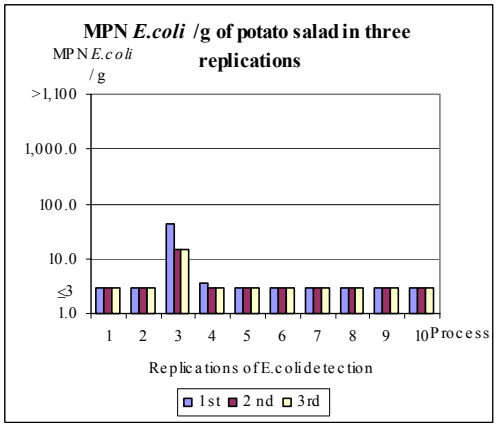


Figure 116 MPN *E.coli* /g with three replications in each step of potato salad preparation.

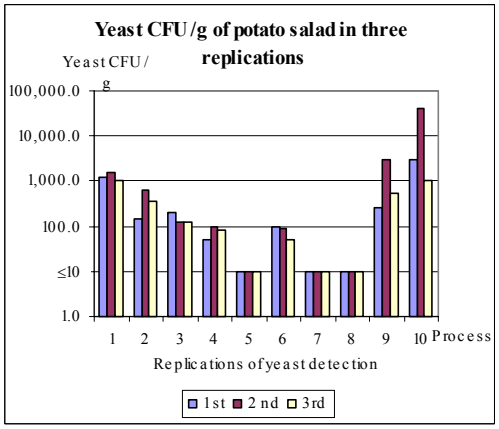


Figure 117 Yeast, CFU /g with three replications in each step of potato salad preparation.

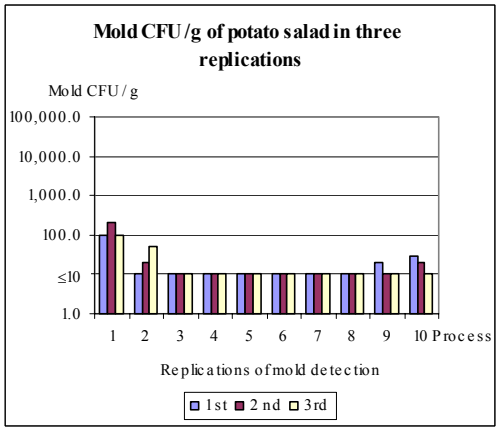


Figure 118 Mold, CFU /g with three replications in each step of potato salad preparation.

The data in table 31 were presented by types of microbiological indicators in potato salad and also shown in Figure 115, 116, 117 and 118.

Preparation steps

Figure 115 showed the number of MPN coliform /g in three replications. In the first replication, it was less than 3 in step 1 and then increased sharply to 75 and 93 in step 2 and 3 respectively. After that it decreased rapidly to 7.3 in step 4 and still decreased to less than 3 in step 5 to 8. Whereas it increased rapidly again to 120 and 460 in step 9 and 10 respectively. In the second replication, it was 3 in step 1, then increased slightly to 15 and 28 in step 2 and 3 respectively. After that it decreased to 7.4 in step 4 and continued decreasing to less than 3 in step 5 to 8. Finally it increased to 24 in step 9. For the third replication, it was less than 3 in step 1 and then increased to 39 in step 2 and increased sharply to 150 in step 3. Next it decreased rapidly to 7.3 in step 4 and still decreased to less than 3 in step 5 to 8, then increased sharply again to 120 in step 9.

Figure 116 showed the number of MPN *E.coli* /g in three replications. In the first replication, it was less than 3 in step 1 and then increased slightly to 3 and 43 in step 2 and 3 respectively. After that it decreased to 3.6 in step 4 and continued decreasing to less than 3 again in step 5 to 9. In the second replication, it was less than 3 in both step 1 and step 2, then decreased slightly to 3 in step 4 and still decreased to less than 3 in step 5 to 9 same as in the first replication. For the third replication, the number was the same as in the second replication.

Figure 117 showed the number of yeast CFU /g in three replications. In the first replication, it was 1.2 x 10^3 CFU /g in step 1 and then decreased rapidly to 150 CFU /g in step 2. Next it increased slightly to 200 CFU /g in step 3, then decreased sharply to 50 and less than 10 in step 4 and 5 respectively. After that it increased rapidly to 100 CFU /g in step 6 and then decreased sharply to less than 10 CFU /g in both step 7 and step 8. Finally it increased sharply to 250 CFU /g in step 9. In the second replication it was 1.5 x 10^3 CFU /g in step 1, then decreased sharply to 650 and 120 in step 2 and 3 respectively and decreased slightly to 100 CFU /g in step 4. After that it decreased rapidly to less than 10 in step 5, next it increased sharply to 90 CFU /g in step 6. Otherwise it decreased sharply to less than 10 CFU /g again in both step 7

and step 8. Finally it increased rapidly to 3.0 x 10^3 CFU /g in step 9. For the third replication, it was 1.0 x 10^3 CFU /g in step 1, then decreased sharply to 350 in step 2 and continued decreasing to 120, 80 and less than 10 CFU /g in step 3, 4 and 5 respectively. After that it increased to 50 CFU /g in step 6, next decreased to less than 10 CFU /g again in both steps 7 and 8. Finally it increased sharply to 550 CFU /g in step 9.

Figure 118 showed the number of mold CFU /g in three replications. In the first replication, it was 100 CFU /g in step 1, then decreased sharply to 10 CFU /g in step 2 and continued decreasing to less than 10 CFU /g in step 3 to 8. After that it increased slightly to 20 CFU /g in step 9. In the second replication, it was 200 CFU /g in step 1 and then decreased sharply to 20 CFU /g in step 2 and still decreased to less than 10 CFU /g in step 3 to 8. In contrast, it increased slightly to 10 CFU /g in step 9. For the third replication, it was 100 CFU /g in step 1, then decreased to 50 CFU /g in step 2 and continued decreasing to less than 10 CFU /g in step 3 to 9.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in each step of three replications.

Time of salad displaying

According to table 31 and figure 115,116,117 and 118 the microbiological quality of salad first displaying and after 2 hrs but not more than 3 hrs of display showed that the number of MPN coliform /g increased from 120.0 to 460.0 an d24.0 to 210.0 in the first and the second replication however, it decreased from 120.0 to 95.0 in the third replication. The number of MPN *E.coli* /g was less than 3 in both first displaying and after 2 hrs but not more than 3 hrs of display of three replications. The number of yeast CFU /g increased from 250 to 3x103, 3x103 to 4x104 and530 to 1x103 CFU /g in the first, the second and the third replication respectively. The number of mold CFU /g increased from 20 to 30, 10 to 20 and less than 10 to 10 CFU /g in the first, the second and the third replication respectively.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in all steps of three replications.

Coleslaw

Table 31 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of coleslaw preparation.

Process	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	23.0	43.0	15.0	<3	<3	<3	$5.7x10^4$	$5.0x10^4$	$4.2x10^4$	10	10	10
2	3.6	7.4	3.6	<3	<3	<3	110	20	20	<10	<10	<10
3	3.6	3.0	3.0	<3	<3	<3	20	10	10	<10	<10	<10
4	<3	<3	<3	<3	<3	<3	$1.8x10^5$	$1.2x10^5$	$1.3x10^5$	<10	<10	<10
5	3.6	7.2	3.6	<3	<3	<3	$1.5 x10^5$	$1.0 x10^5$	$1.1 x10^5$	<10	<10	<10
6	120.0	150.0	35.0	<3	<3	<3	$4.0 x10^3$	$1.0 x10^4$	$2.0 x10^4$	10	<10	<10
7	<3	<3	<3	<3	<3	<3	100	80	120	<10	<10	<10
8	210.0	150.0	150.0	<3	<3	<3	$3.2x10^3$	$2.0x10^3$	$2.3x10^3$	<10	10	10
9	240.0	290.0	290.0	<3	<3	<3	$4.0 x10^3$	$2.5 x10^3$	$2.8 x10^3$	<10	20	20

❶ ❷ ❸

→ Peeling and shredding carrot → keeping in fridge

❹ ❺ ❻ ❽ ❾

→ Peeling and slicing cabbage→ keeping in fridge → mixing→ displaying → after displaying2hrs

❼

mayonnaise

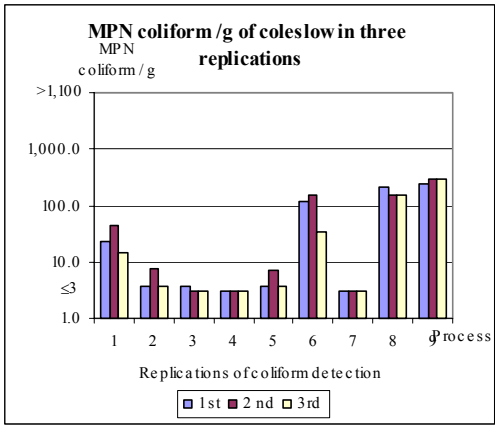


Figure 119 MPN coliform /g with three replications in each step of coleslaw preparation.

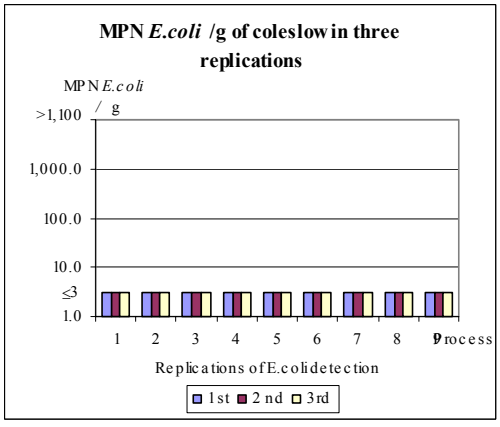


Figure 120 MPN *E.coli* /g with three replications in each step of coleslaw preparation.

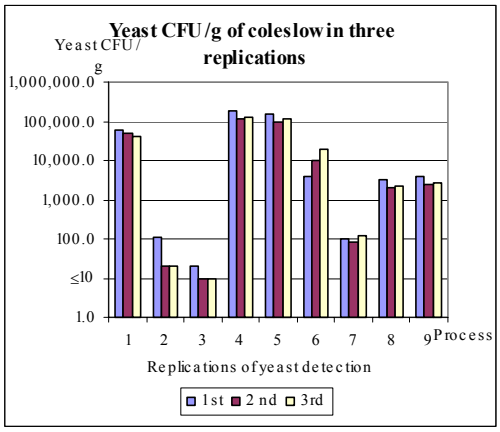


Figure 121 Yeast, CFU /g with three replications in each step of coleslaw preparation.

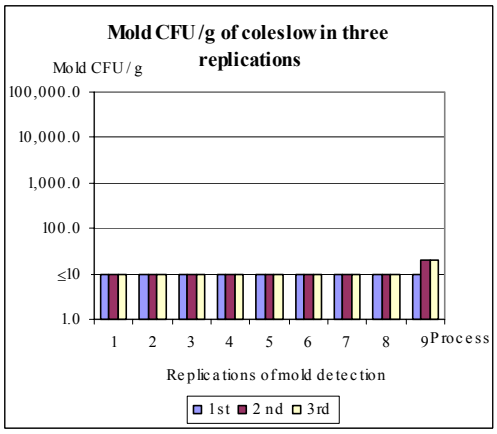


Figure 122 Mold, CFU /g with three replications in each step of coleslaw preparation.

The data in table 32 were presented by types of microbiological indicators in coleslaw and also shown in Figure 119, 120, 121 and 122.

Preparation steps

Figure 119 showed the number of MPN coliform /g in three replications. In the first replication, it was 23 in step 1, then decreased slightly to 3.6 in both step 2 and step 3 and continued decreasing to less than 3 in step 4. However it increased to 3.6 again in step 5, next increased rapidly to 120 in step 6. On the other hand, it decreased sharply to less than 3 again in step 7. Finally it increased rapidly to 210 in step 8. In the second replication, it was 43 in step 1 and then decreased to 7.4, 3.0 and less than 3 in step 2, 3 and 4 respectively. After that it increased slightly to 7.2 in step 5 and still increased sharply to 150 in step 6. In contrast, it decreased rapidly to less than 3 in step 7 but increased sharply to 150 again in step 8. For the third replication, it was 15 in step 1, then decreased slightly to 3.6, 3.0 and less than 3 in step 2, 3 and 4 respectively. However it increased slightly to less than 3 in step 7. Finally it increased sharply to 150 in step 8.

Figure 120 showed the number of MPN *E.coli* /g in three replications. It was less than 3 in all steps of three replications.

Figure 121 showed the number of yeast CFU /g in three replications. In the first replication, it was 5.7 x 10^4 CFU /g in step 1, then decreased rapidly to 110 and 20 CFU /g in step 2 and 3 respectively. On the other hand, it increased sharply to 1.8 x 10^5 CFU /g in step 4 and then decreased slightly to 1.5 x 10^5 CFU /g in step 5 and still decreased to 4.0 x 10^3 CFU /g in step 6. However it decreased rapidly to 100 CFU /g in step 7, but increased sharply to 3.2 x 10^3 CFU /g in step 8. In the second replication, it was 5.0 x 10^4 CFU /g in step 1 and then decreased rapidly to 20 and 10 CFU /g in step 2 and 3 respectively. In contrast it increased sharply to1.2 x 10^5 CFU /g in step 4, after that decreased slightly to 1.0 x 10^5 CFU /g in step 5 and still decreased to 1.0 x10^4 CFU /g in step 6.Whereas it decreased rapidly to 80 CFU /g in step 7, finally increased sharply to 2.0 x 10^3 CFU /g in step 8. In the third replication, it was 4.2 x 10^4 CFU /g in step 1, then decreased rapidly to 20 and 10 CFU /g in step 2 and 3 respectively. After that it increased sharply to 1.3 x 10^5 CFU /g in step 4, next decreased to 1.1 x 10^5 and 2.0 x 10^4 CFU /g in step 5 and 6 respectively. Otherwise it decreased rapidly to 120 CFU /g in step 7. Finally it increased sharply to 2.3 x 10^3 in step 8.

Figure 122 showed the number of mold CFU /g in three replications. In the first replication, it was 10 CFU /g in step 1 and then decreased slightly to less than 10 CFU /g in step 2 to 5. In contrast, it increased slightly to 10 CFU /g again in step 6. Finally it decreased slightly to less than 10 CFU /g in step 7 and 8. In the second replication, it was 10 CFU /g in step 1, then decreased slightly to less than 10 CFU /g in step 2 to 7. After that it increased slightly to 10 in step 8. For the third replication, the number of mold was the same pattern as in the second replication.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in each step of three replications.

Time of salad displaying

According to table 32 and figure 119,120,121 and 122 the microbiological quality of salad first displaying and after 2 hrs but not more than 3 hrs of display showed that the number of MPN coliform /g increased from 210.0 to 240.0 in the first replication and increased from 150 to 290 in both the second and the third replication.

The number of MPN *E.coli* /g was less than 3 in both first displaying and after 2 hrs but not more than 3 hrs of display of three replications. The number of yeast CFU /g increased from 3.2x103 to 4.0x104, 2.0x103 to 2.5x103 and 2.3x103 to 2.8x10 3 CFU /g in the first, the second and the third replication respectively. The number of mold CFU /g was less than 10 in both first displaying and after 2 hrs but not more than3 hrs of display of the first replication. It increased from 10 to 20 CFU /g in the second and the third replication.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in all steps of three replications.

Apple salad

Table 32 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of apple salad preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	15.0	3.0	<3	<3	<3	<3	<10	20	10	<10	10	<10
2	<3	<3	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10
3	<3	<3	<3	<3	<3	<3	100	50	100	10	<10	<10
4	<3	<3	<3	<3	<3	<3	150	100	130	<10	<10	<10
5	<3	6.1	<3	<3	3.0	<3	100	120	120	<10	10	10

❶ ❷ ❸ ❹

→ Cutting → cleaning → mayonnaise → mixing → displaying

❺

→ after displaying 2 hrs

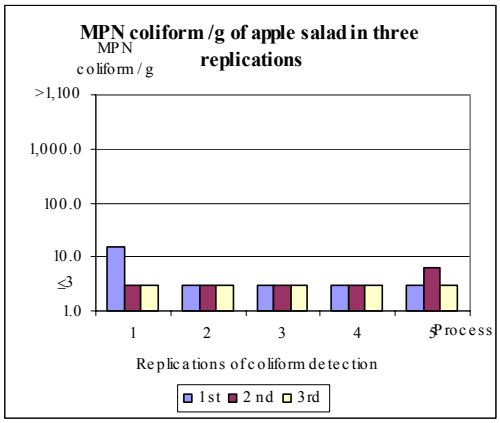


Figure 123 MPN coliform /g with three replications in each step of apple salad preparation.

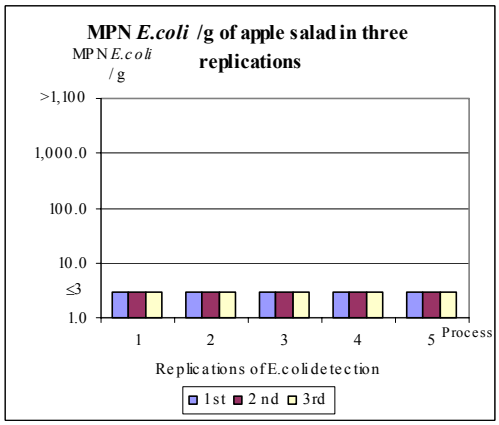


Figure 124 MPN *E.coli* /g with three replications in each step of apple salad preparation.

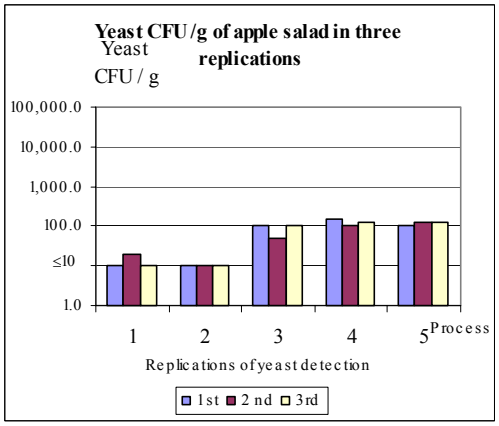


Figure 125 Yeast, CFU /g with three replications in each step of apple salad preparation.

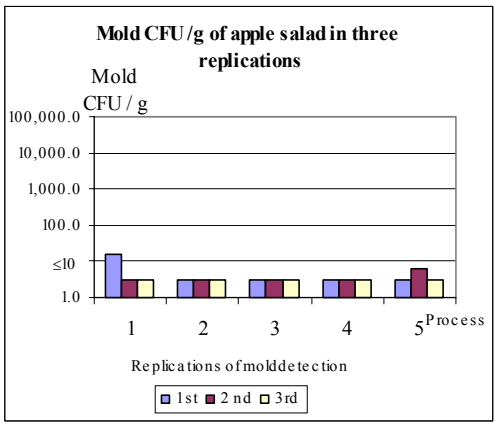


Figure 126 Mold, CFU /g with three replications in each step of apple salad preparation.

The data in table 33 were presented by types of microbiological indicators in apple salad and also shown in Figure 123, 124, 125 and 126.

Preparation steps

Figure 123 showed the number of MPN coliform bacteria /g in three replications. In the first replication, it was 15 in step 1 and then decreased slightly to less than 3 in step 2 to step 4. In the second replication, it was 3 in step 1, next

decreased slightly to less than 3 in step 2, 3 and 4. For the third replication, it was less than 3 in all steps.

Figure 124 showed the number of MPN *E.coli* /g in three replications. It was less than 3 in all steps of the first and the second replications. For the third replication, it was less than 3 in step 1 to 4.

Figure 125 showed the number of yeast CFU /g in three following replications. In the first replication, it was less than 10 CFU /g in both step 1 and step 2, then increased sharply to 100 and 150 CFU /g in step 3 and 4 respectively. In the second replication, it was 20 CFU /g in step 1, next decreased slightly to less than 10 CFU /g in step 2. After that it increased to 50 and 100 CFU /g in step 3 and 4 respectively. In the third replication, it was 10 CFU /g in step 1, then decreased slightly to less than 10 CFU /g in step 2. However it increased rapidly to 100 and 130 CFU /g in step 3 and 4 respectively.

Figure 126 showed the number of mold CFU /g in three replications. In the first replication, it was less than 10 CFU /g in both step 1 and step 2, then decreased slightly to 10 CFU /g in step 3. After that it decreased slightly to less than 10 CFU /g again in step 4. In the second replication, it was 10 CFU /g in step 1 then decreased slightly to less than 10 CFU /g in step 2, 3 and 4. In the third replication, it was less than 10 CFU /g in step 1 to 4.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in all steps of three replications.

Time of salad displaying

According to table 33 and figure 123,124,125 and 126 the microbiological quality of salad first displaying and after 2 hrs but not more than 3 hrs of display showed that the number of MPN coliform /g was less than 3 in both first displaying and after 2 hrs but not more than 3 hrs of display of the first and the third replication. It increased from less than 3 to 6.1 in the second replication. The number of MPN *E.coli* /g was less than 3 in both first displaying and after 2 hrs but not more than 3 hrs of display of the first and the third replication whereas it increased from less than 3 to 3.0 in the second replication.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in each step of three replications.

Red kidney bean

Table 33 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of red kidney bean preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	<3	<3	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10
2	<3	<3	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10

❶ ❷

Decaning → displaying → after displaying 2 hrs

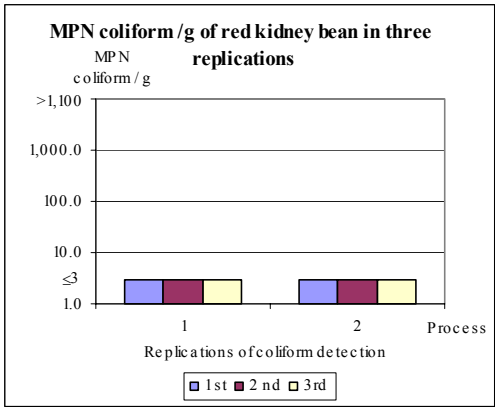


Figure 127 MPN coliform /g with three replications in each step of red kidney bean preparation.

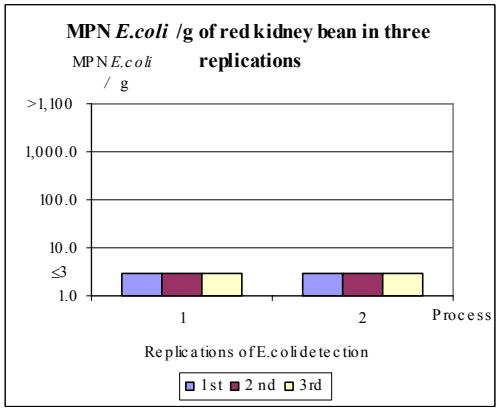


Figure 128 MPN *E.coli* /g with three replications in each step of red kidney bean preparation.

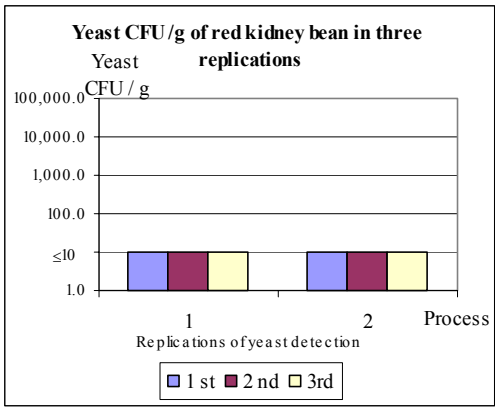


Figure 129 Yeast, CFU /g with three replications in each step of red kidney bean preparation.

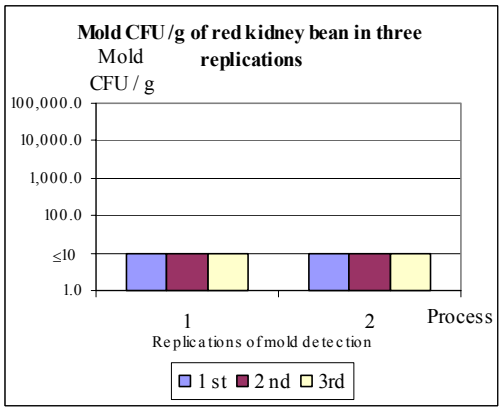


Figure 130 Mold, CFU /g with three replications in each step of red kidney bean preparation.

The data in table 34 were presented by types of microbiological indicators in red kidney bean and also shown in Figure 127, 128, 129 and 130.

Preparation steps

Figure 127 showed the number of MPN coliform /g in three replications. It was less than 3 in all steps of three replications.

Figure 128 showed the number of MPN *E.coli* /g in three replications. It was less than 3 in all steps of three replications.

Figure 129 showed the number of yeast CFU /g in three replications. It was less than 10 in each step of all replications.

Figure 130 showed the number of mold CFU /g in three replications. It was less than 10 in each step of all replications.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in all steps of three replications.

Time of salad displaying

According to table 34 and figure 127,128,129 and 130 the microbiological quality of salad first displaying and after 2 hrs but not more than 3 hrs of display showed that the number of MPN coliform /g and MPN *E.coli* /g was less than 3 in first

displaying and after 2 hrs but not more than 3 hrs of display in three replication. The number of yeast CFU /g and mold CFU /g was less than 10 in both first displaying and after 2 hrs but not more than 3 hrs of display in three replications.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp.*, *Vibrio cholerae* and *Clostridium perfringens* in all steps of three replications.

Garden pea

Table 34 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of garden pea preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	<3	<3	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10
2	<3	<3	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10

❶ ❷

Decaning → displaying → after displaying 2 hrs

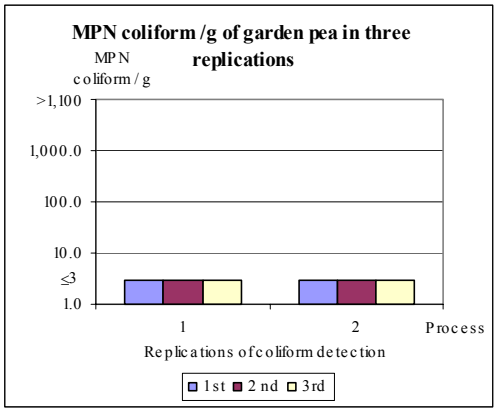


Figure 131 MPN coliform /g with three replications in each step of garden pea preparation.

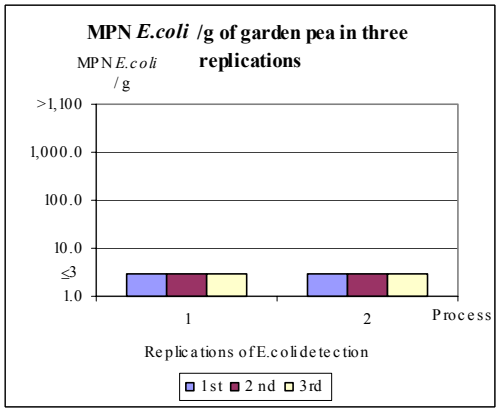


Figure 132 MPN *E.coli* /g with three replications in each step of garden pea preparation.

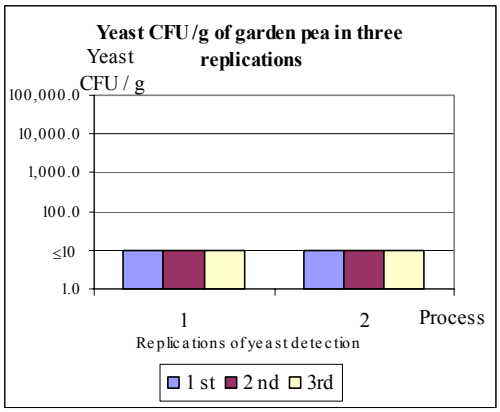


Figure 133 Yeast, CFU /g with three replications in each step of garden pea preparation.

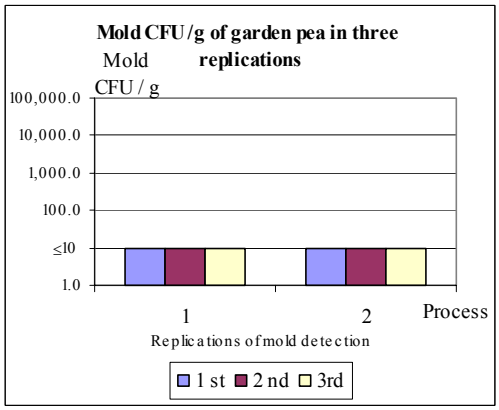


Figure 134 Mold, CFU /g with three replications in each step of garden pea preparation.

The data in table 35 were presented by types of microbiological indicators in garden pea and also shown in Figure 131, 132, 133 and 134.

Preparation steps

Figure 131 showed the number of MPN coliform /g in three replications. It was less than 3 in all steps of three replications.

Figure 132 showed the number of MPN *E.coli* /g in three replications. It was less than 3 in all steps of three replications.

Figure 133 showed the number of yeast CFU /g in three replications. It was less than 10 in each step of all replications.

Figure 134 showed the number of mold CFU /g in three replications. It was less than 10 in each step of all replications.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in all steps of three replications.

Time of salad displaying

According to table 35 and figure 131,132,133 and 134 the microbiological quality of salad first displaying and after 2 hrs but not more than 3 hrs of display showed that the number of MPN coliform /g and MPN *E.coli* /g was less than 3 in first

displaying and after 2 hrs but not more than 3 hrs of display in three replication. The number of yeast CFU /g and mold CFU /g was less than 10 in both first displaying and after 2 hrs but not more than 3 hrs of display in three replications.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp.*, *Vibrio cholerae* and *Clostridium perfringens* in all steps of three replications.

Jelly

Table 35 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of jelly preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	<3	<3	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10
2	<3	<3	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10

❶ ❷

Decaning → displaying → after displaying 2 hrs

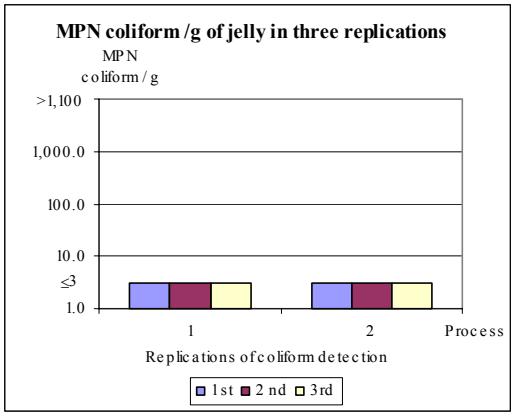


Figure 135 MPN coliform /g with three replications in each step of jelly preparation.

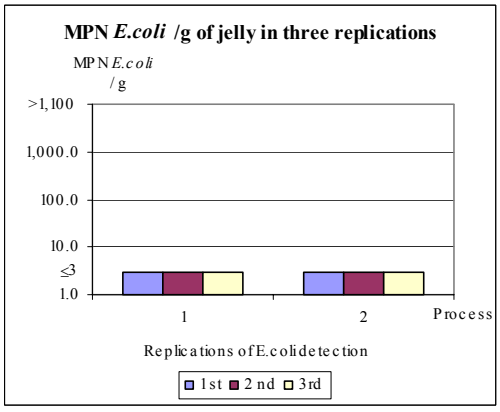


Figure 136 MPN *E.coli* /g with three replications in each step of jelly preparation.

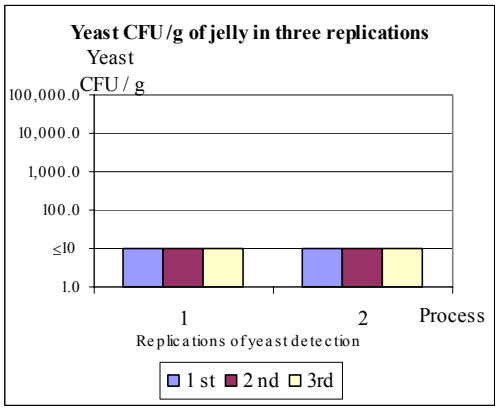


Figure 137 Yeast, CFU /g with three replications in each step of jelly preparation.

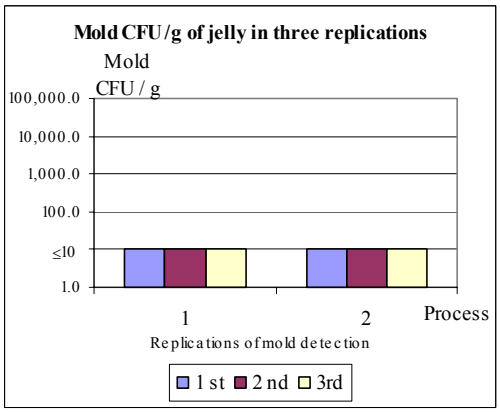


Figure 138 Mold, CFU /g with three replications in each step of jelly preparation.

The data in table 36 were presented by types of microbiological indicators in jelly and also shown in Figure 135, 136, 137 and 138.

Preparation steps

Figure 135 showed the number of MPN coliform /g in three replications. It was less than 3 in all steps of three replications.

Figure 136 showed the number of MPN *E.coli* /g in three replications. It was less than 3 in all steps of three replications.

Figure 137 showed the number of yeast CFU /g in three replications. It was less than 10 in each step of all replications.

Figure 138 showed the number of mold CFU /g in three replications. It was less than 10 in each step of all replications.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in all steps of three replications.

Time of salad displaying

According to table 36 and figure 135,136,137 and 138 the microbiological quality of salad first displaying and after 2 hrs but not more than 3 hrs of display showed that the number of MPN coliform /g and MPN *E.coli* /g was less than 3 in first

displaying and after 2 hrs but not more than 3 hrs of display in three replication. The number of yeast CFU /g and mold CFU /g was less than 10 in both first displaying and after 2 hrs but not more than 3 hrs of display in three replications.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp.*, *Vibrio cholerae* and *Clostridium perfringens* in all steps of three replications.

Water nut

Table 36 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of water nut preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	<3	<3	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10
2	<3	<3	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10

❶ ❷

Decaning → displaying → after displaying 2 hrs

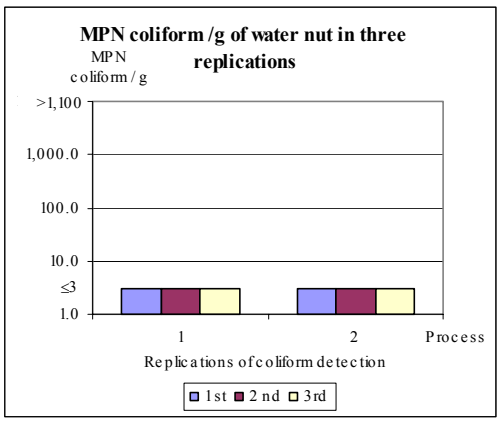


Figure 139 MPN coliform /g with three replications in each step of water nut preparation.

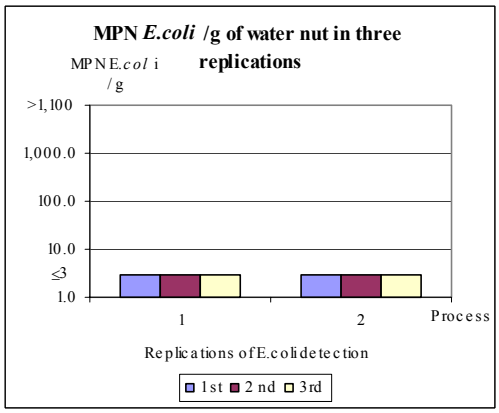


Figure 140 MPN *E.coli* /g with three replications in each step of water nut preparation.

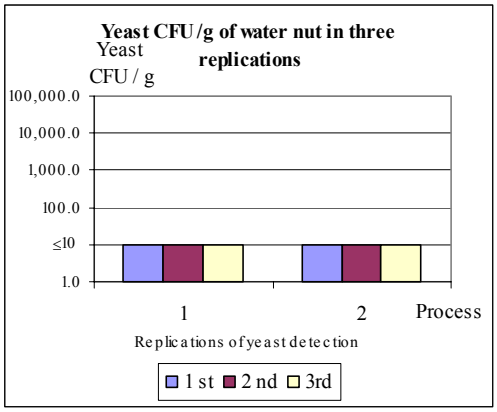


Figure 141 Yeast, CFU /g with three replications in each step of water nut preparation.

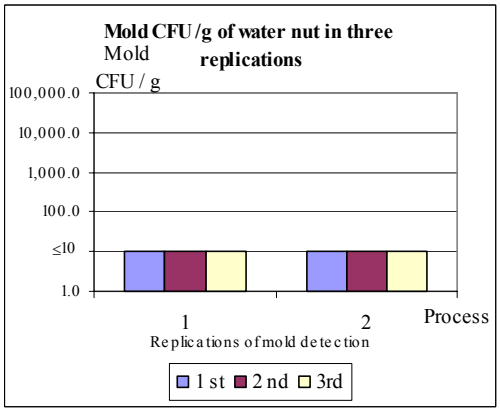


Figure 142 Mold, CFU /g with three replications in each step of water nut preparation.

The data in table 37 were presented by types of microbiological indicators in water nut and also shown in Figure 139, 140, 141 and 142.

Preparation steps

Figure 139 showed the number of MPN coliform /g in three replications. It was less than 3 in all steps of three replications.

Figure 140 showed the number of MPN *E.coli* /g in three replications. It was less than 3 in all steps of three replications.

Figure 141 showed the number of yeast CFU /g in three replications. It was less than 10 in each step of all replications.

Figure 142 showed the number of mold CFU /g in three replications. It was less than 10 in each step of all replications.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in all steps of three replications.

Time of salad displaying

According to table 37 and figure 139,140,141 and 142 the microbiological quality of salad first displaying and after 2 hrs but not more than 3 hrs of display

showed that the number of MPN coliform /g and MPN *E.coli* /g was less than 3 in first displaying and after 2 hrs but not more than 3 hrs of display in three replication. The number of yeast CFU /g and mold CFU /g was less than 10 in both first displaying and after 2 hrs but not more than 3 hrs of display in three replications.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in all steps of three replications.

Corn

Table 37 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in each step of corn preparation.

Process (Step)	MPN coliform / g			MPN *E.coli* / g			Yeast CFU / g			Mold CFU / g		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
1	<3	<3	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10
2	<3	<3	<3	<3	<3	<3	<10	<10	<10	<10	<10	<10

❶ ❷

Decaning → displaying → after displaying 2 hrs

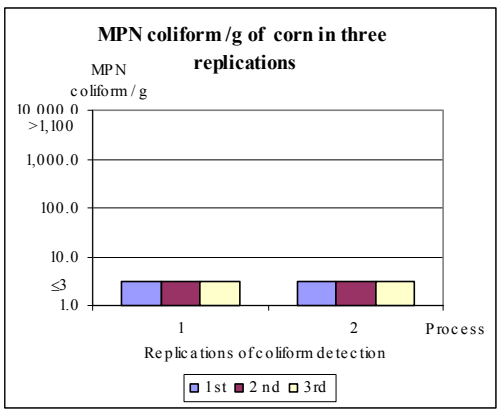


Figure 143 MPN coliform /g with three replications in each step of corn preparation.

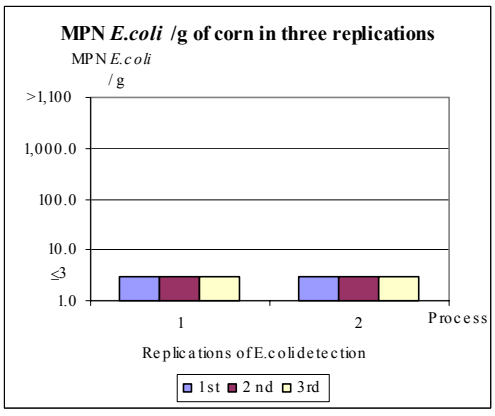


Figure 144 MPN *E.coli* /g with three replications in each step of corn preparation.

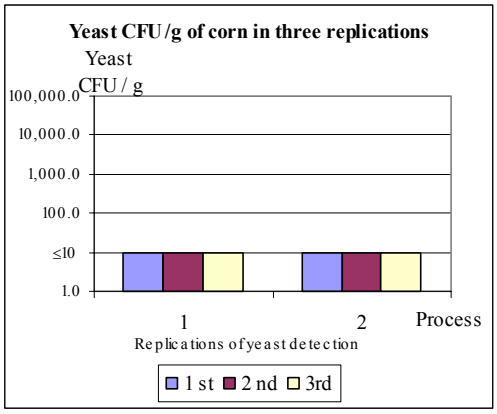


Figure 145 Yeast, CFU /g with three replications in each step of corn preparation.

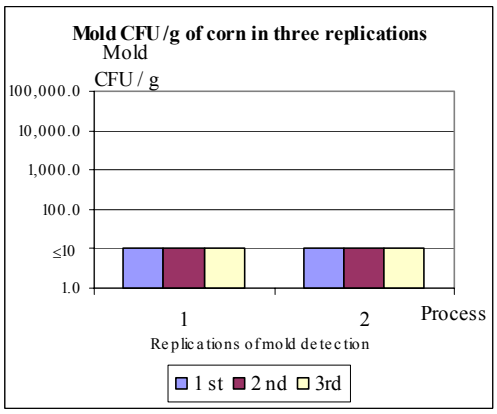


Figure 146 Mold, CFU /g with three replications in each step of corn preparation.

The data in table 37 were presented by types of microbiological indicators in water nut and also shown in Figure 143, 144, 145 and 146.

Preparation steps

Figure 143 showed the number of MPN coliform /g in three replications. It was less than 3 in all steps of three replications.

Figure 144 showed the number of MPN *E.coli* /g in three replications. It was less than 3 in all steps of three replications.

Figure 145 showed the number of yeast CFU /g in three replications. It was less than 3 in each step of all replications.

Figure 146 showed the number of mold CFU /g in three replications. It was less than 3 in each step of all replications.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in all steps of three replications.

Time of salad displaying

According to table 38 and figure 143,144,145 and 146 the microbiological quality of salad first displaying and after 2 hrs but not more than 3 hrs of display

showed that the number of MPN coliform /g and MPN *E.coli* /g was less than 3 in first displaying and after 2 hrs but not more than 3 hrs of display in three replication. The number of yeast CFU /g and mold CFU /g was less than 10 in both first displaying and after 2 hrs but not more than 3 hrs of display in three replications.

For pathogenic organisms there was no growth of *Staphylococcus aureus*, *Salmonella spp*., *Vibrio cholerae* and *Clostridium perfringens* in all steps of three replications.

Microbiological quality of 12 ingredients of salad sold by street vendor showed that 3 of 8 fresh ingredients and 4 of 5 boiled ingredients which were cucumber, lettuce, cabbage, red kidney bean, barley, boiled sweet potato and corn found the amount of microbiological hazards were higher than the standard of the Department of Medical Science.

In step of cucumber preparations detected coliform bacteria and yeast in raw material thus coliform bacteria was detected in any steps of lettuce preparations exclude step after cleaning while, *E.coli* was detected in raw material and yeast was detected in both raw material and step of displaying. *Clostridium perfringens* and *Vibrio cholerae* non O1 were detected in raw material as well. Cabbage found *E.coli* in raw material and step of displaying and also found *Salmonella* group C in raw material.

In step of red kidney bean preparations, only coliform bacteria was detected in step of displaying whereas coliform bacteria and *E.coli* were detected in displaying step of barley and also found *Salmonella* group E in step after putting in water and *Staphylococcus aureus* in step of displaying. For boiled sweet potato and corn found coliform bacteria and *E.coli* in both raw material and displaying step and also found yeast in raw material.

Microbiological quality of mayonnaise dressing showed that there were not any steps that higher than the standard of the Department of Medical Science.

The amount of microbiological hazards of 23 ingredients of salad bar in supermarket showed that 6 of 9 fresh ingredients, 6 of 6 boiled ingredients and 2 of 8 miscellaneous ingredients which were tomato, lettuce, cantaloupe, red cabbage, cabbage, carrot, baby corn, asparagus, potato, taro, pumpkin, mixed vegetables, potato

salad and coleslaw found the amount of microbiological hazards higher than the standard of the Department of Medical Science.

In step of tomato preparations detected coliform bacteria in displaying step whereas coliform bacteria and yeast were detected in raw material and step after cutting of lettuce and found *E.coli* in raw material and displaying step as well. Cantaloupe found coliform bacteria and *E.coli* in raw material while, yeast was detected in raw material and step after slicing of both red cabbage and cabbage thus, it was found in raw material and step after cutting of carrot.

In step of boiled ingredients preparations found coliform bacteria in raw material and step after cutting, *E.coli* in step after cutting of baby corn, *E.coli* in raw material and yeast in raw material and step after cutting of asparagus, *E.coli* in step after putting in water and yeast in raw material and step after cutting of potato, also found coliform bacteria and yeast in both raw material and step after putting in water of taro, coliform bacteria and yeast in raw material of pumpkin and coliform and yeast in raw material and step after cutting of mixed vegetables

Microbiological quality of miscellaneous ingredients showed that 2 of 8 ingredients which were potato salad and coleslaw found the amount of microbiological hazards higher than the standard of the Department of Medical Science. In steps of potato salad preparations detected *E.coli* in step after putting in water and also found yeast in raw material, step after cutting and displaying step of coleslaw preparations.

4.3 Microbiological contamination on food contact surfaces of street vendor

Table 38 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in food contact surface of street vendor.

Food contact surface	Total plate count (CFU / piece)			*E.coli*			Yeast (CFU / piece)			Mold (CFU / piece)		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
Knife	50	<10	<10	-	-	-	<10	<10	<10	<10	<10	<10
Chopping block	$4.2x10^4$	$7.0x10^3$	$2x10^4$	-	-	-	<10	<10	<10	<10	<10	<10
Tray	150	150	200	-	-	-	<10	<10	<10	<10	<10	<10
A two edged knife	<10	<10	<10	-	-	-	<10	<10	<10	<10	<10	<10
Hand	200	700	$6.3x10^2$	-	-	-	<10	<10	<10	<10	<10	<10
Plastic bowl	20	50	<10	-	-	-	<10	<10	<10	<10	<10	<10
Tongs	40	<10	20	-	-	-	<10	<10	<10	<10	<10	<10
Ladle	20	40	20	-	-	-	<10	<10	<10	<10	<10	<10
Nylon robe	450	150	530	-	-	-	<10	<10	<10	<10	<10	<10
Water	<10	<10	<10	-	-	-	<10	<10	<10	<10	<10	<10

Ten food contact surfaces; knife, chopping block, tray, a two edged knife, hand, plastic bowl, tongs, ladle, nylon robe and water were analyzed for microbiological contamination. The results were showed in Table 38.

Table 38 showed the number of microbiological contamination on food contact surfaces in three replications. The number of total bacteria was in the range from less than 10 to 4.2 x 10^4 CFU / piece, only in chopping block was more than the Standard of the Department of Medical Science. *E.coli* was not detected in any utensils .The number of yeast and mold was less than 10 CFU /g in all utensils.

4.4 Microbiological contamination on food contact surfaces of salads in supermarket.

Table 39 The number of coliform bacteria, *E.coli*, yeast and mold with three replications in food contact surface of salad in supermarket.

Food contact surface	Total plate count (CFU / piece)			*E.coli*			Yeast (CFU / piece)			Mold (CFU / piece)		
	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd	1 st	2 nd	3rd
Knife	210	15	20	-	-	-	<10	<10	<10	<10	<10	<10
Chopping block	$5.0x10^4$	$4.6x10^4$	$4.2x10^4$	-	-	-	<10	<10	<10	<10	<10	<10
Tray	20	30	<10	-	-	-	<10	<10	<10	<10	<10	<10
A two edged knife	250	<10	$2.0x10^2$	-	-	-	<10	<10	<10	<10	<10	<10
Hand	650	150	40	-	-	-	<10	<10	<10	<10	<10	<10
Plastic bowl	10	40	20	-	-	-						
Tongs	20	30	<10	-	-	-	<10	<10	<10	<10	<10	<10
Ladle	20	20	<10	-	-	-	<10	<10	<10	<10	<10	<10
water	<10	<10	<10	-	-	-	<10	<10	<10	<10	<10	<10

Nine food contact surfaces; knife, chopping block, tray, a two edged knife, hand, plastic bowl, tongs, ladle and water were analyzed for microbiological contamination. The results were showed in Table 39.

Table 39 showed the number of microbiological contamination on food contact surface in three replications. The number of total bacteria was in the range from less than 10 to 5.0 x 10^4 CFU / piece, only in chopping block was more than the Standard of the Department of Medical Science. *E.coli* was not detected in any utensils .The number of yeast and mold was less than 10 CFU /g in all utensils.

4.5 Determination of Critical Control Points (CCPs)

4.5.1 Determination of Critical Control Points (CCPs) of salads sold by street food vendor.

Critical Control Points (CCPs) of salads sold by street food vendor were determined from three main groups of salad ingredients: fresh ingredients, boiled ingredients and mayonnaise dressing.

The fresh ingredients consisted of cucumber, lettuce, tomato, onion, carrot, cabbage and pineapple. The main Preparation steps are peeling, cleaning, cutting and displaying. Based upon the microbiological hazards results of salad Preparation steps compared with the microbiological standard of the Department of Medical Science showed that salad raw ingredients were contaminated by coliform bacteria, *E.coli, Salmonella spp. Vibrio Cholerae* and *Clostridium perfringens*, that sometime higher than the microbiological standard of the Department of Medical Science, then the ingredients were cleaned, microbiological indicators were killed and reduced to the acceptable level. So cleaning is an important step and an operation after cleaning, slicing cutting and displaying are also important. The result from using Decision tree recommended by World Health Organization (WHO) concluded that cleaning, slicing, cutting and displaying steps are the Critical Control Point of fresh ingredient preparation.

The boiled ingredients were composed of red kidney bean, boiled egg, barley, boiled sweet potato and corn. The Preparation steps of red kidney bean were putting in water, boiling and displaying, which are the same step as barley. Eventually the Preparation steps of both boiled egg and corn were boiling and displaying, while boiled sweet potato was prepared by step of peeling, cutting, cleaning, boiling and displaying.

The microbiological hazards results of salad Preparation steps compared with the microbiological standard of the Department of Medical Science showed that raw potatoes were contaminated by coliform bacteria, *E.coli*, yeast and mold. Some of them had the number of microbiological indicators higher than the microbiological standard of the Department of Medical Science. Until they were boiled with higher temperature, the indicator microorganisms were killed and reduced to the acceptable level. Thereby boiling is the necessary step, cleaning and displaying steps are also important, similar to the result from using Decision tree recommended by World Health Organization (WHO). So the Critical Control Points of Preparation steps of boiled ingredients are the boiling, cleaning and displaying steps.

Mayonnaise dressing consisted of vinegar, lemon, oil, yolk egg, salt, sugar and mustard. The Preparation steps of mayonnaise dressing is mixing all of the ingredients together.

The microbiological hazards results of mayonnaise dressing compared with the microbiological standard of the Department of Medical Science showed that the number of coliform bacteria, *E.coli*, yeast and mold detected in the Preparation steps were in the acceptable level. The result from using decision tree recommended by World Health Organization (WHO) concluded that there are no Critical Control Points in mayonnaise preparation.

4.5.2 Determination of the Critical Control Points (CCPs) of salad bar in supermarket.

Critical Control Points (CCPs) of salad in supermarket were determined from three main groups of salad ingredients: fresh ingredients, boiled ingredients and miscellaneous ingredients.

The fresh ingredients consisted of cucumber, tomato, onion, lettuce, pineapple, cantaloupe, red cabbage, cabbage and carrot. The Preparation steps of fresh ingredients were quite the same. The Preparation steps of cucumber and onion are peeling, cleaning, slicing and displaying. For preparing tomato the steps were almost the same as the Preparation steps of cucumber and onion but there is no peeling step. The Preparation steps of lettuce were cutting, cleaning and displaying whereas the Preparation steps of pineapple and cantaloupe were peeling, cutting and displaying. For red cabbage, cantaloupe and carrot, the Preparation steps were shredding, keeping in refrigerator and displaying.

Based upon the microbiological hazards results of salad Preparation steps compared with the microbiological standard of the Department of Medical Science showed that Preparation steps of fresh ingredients were contaminated by coliform bacteria, *E.coli*, yeast and mold but only coliform bacteria detection in raw ingredients of lettuce was higher than the microbiological number of the microbiological standard of the Department of Medical Science Thus when it was cleaned, coliform bacteria were reduced to the acceptable level. So the cleaning step is an important step. The result from using Decision tree recommended by World Health Organization (WHO) for determining the Critical Control Points (CCPs) of fresh ingredients showed that the cleaning, slicing and displaying steps are the Critical Control Points (CCPs) of cucumber, tomato and onion preparations, while cutting and displaying steps are the Critical Control Points (CCPs) of pineapple and cantaloupe

preparations thus cleaning and displaying steps are the Critical Control Points (CCPs) of lettuce, red cabbage, cabbage and carrot preparations.

The boiled ingredients were composed of baby corn, asparagus, potato, taro, pumpkin and mixed vegetables. The Preparation steps are peeling, cutting, putting in water, cleaning, boiling, dewatering, keeping in refrigerator and displaying.

The microbiological hazards results of salad Preparation steps compared with the microbiological standard of the Department of Medical Science showed that the preparation steps of boiled ingredients were contaminated by coliform bacteria, *E.coli*, yeast and mold. Raw ingredients of the Preparation steps of baby corn and taro were contaminated by coliform bacteria and *E.coli* as well as raw ingredients of mixed vegetables were contaminated by coliform bacteria, yeast and mold. While raw ingredients of asparagus were contaminated by only *E.coli*. Most of the contamination were higher than the microbiological standard of the Department of Medical Science. After they were boiled with high temperature, indicator microorganisms were killed and reduced to the acceptable level. Thereby the boiling is the important step and the displaying step is also important, similar to the result from using Decision tree recommended by World Health Organization (WHO). So the Critical Control Points (CCPs) of Preparation steps of boiled ingredients are the boiling and displaying steps excluded potato preparations, The Critical Control Points (CCPs) are the cleaning, boiling and displaying steps

The miscellaneous ingredients consisted of potato salad, coleslaw, apple salad, red kidney bean, jelly, garden pea, corn and water nut. The main Preparation steps of potato salad, coleslaw and apple salad were cutting, shredding, cleaning, mixing with mayonnaise and displaying.

The microbiological hazards results of potato salad Preparation steps compared with the microbiological standard of the Department of Medical Science showed that the Preparation steps of potato salad were contaminated by coliform bacteria, *E.coli*, yeast and mold, but only *E.coli* detection in the steps before cleaning: raw ingredient and step after peeling is higher than the microbiological standard of the Department of Medical Science. Until it was cleaned and boiled, *E.coli* was reduced to the acceptable level. Therefore cleaning and boiling are the important steps, and an operation after cleaning and boiling, displaying is also important. The result from

using Decision thee recommended by World Health Organization showed that the cleaning boiling, and displaying steps are the Critical Control Points (CCPs) of potato salad preparation.

Based upon the microbiological hazards results of apple salad Preparation steps compared with the microbiological standard of the Department of Medical Science showed that the Preparation steps of apple salad were contaminated by coliform bacteria, *E.coli*, yeast and mold, but all of the contaminations were in the acceptable levels. Eventually the result from using Decision tree recommended by World Health Organization illustrated that the cleaning and displaying steps are the Critical Control Points (CCPs) of apple salad preparation.

From the microbiological hazards results of coleslaw Preparation steps compared with the microbiological standard of the Department of Medical Science showed that the Preparation steps of potato salad were contaminated by coliform bacteria, *E.coli*, yeast and mold, but only yeast contamination in raw cabbage and shredded cabbage were higher than the microbiological standard of the Department of Medical Science. Thus it was kept in refrigerator; yeast was reduced to the acceptable level. In contrast, the result from using Decision tree recommended by World Health Organization showed that only the displaying step is the Critical Control Points (CCPs) of coleslaw preparation.

Based on the microbiological hazards results of canned ingredients, jelly, garden pea, corn and water nut Preparation steps compared with the microbiological standard of the Department of Medical Science showed that coliform bacteria, *E.coli*, yeast and mold detected in the Preparation steps were in the acceptable levels. The results from using Decision tree recommended by World Health Organization showed that only the displaying step is the Critical Control Points (CCPs) of canned ingredients.

CHAPTER V
DISCUSSION

5.1 Preparation

5.1.1 Salad sold by street vendor

It was found that almost salad ingredients prepared for sale by street vendor were highly contaminated by coliform bacteria and *E.coli* higher than the microbiological standard of the Department of Medical Science.

Coliform bacteria is an indicator of water quality and sanitary condition in the food processing environment, whereas *E.coli* is an indicator of fecal contamination. The major sources of *E.coli* in environment are probably the faeces of infected humans, and animal reservoirs, as well. Faeces and untreated water are the most likely source for contamination of food (18).

The results showed that yeast and mold were found during preparation of fresh ingredients. Both yeast and mold can cause various degrees of deterioration and decomposition of invaded food crops such as grains, nuts, beans and fruits in fields before harvesting and during storage. They can grow on processed food and food mixture. They can invade and grow on type of food at any time.

Fruits and vegetables were contaminated with pathogenic microorganisms while growth in fields or orchards or during harvesting, post harvesting, handling, processing and distribution (2). Animal manure and contaminated irrigation can cause contamination of food. Many studies reported that bacteria have been associated with consumption of raw vegetables (29,32,33,34,35,36). Madden (37) reported that contaminated irrigation water, improper human handling, contaminated containers, animal fertilizers and post-harvest washing can be sources of microbial contamination of vegetables.

The result of microbiological determination showed that the microbiological contamination was higher than the microbiological standard of the Department of Medical Science in almost every steps of preparation including steps

after cleaning because the complex multi-layered surfaces of salad are more difficult to clean after picking than to produce with a smooth surface (38).

The number of *Vibrio cholerae* non O1/non O139 and *Clostridium perfringens* were isolated in preparation steps of lettuce. *Clostridium perfringens* spores persist in soil sediments and areas subject to human or animal fecal pollution. It transmits from human faeces via hands to the food by direct contact, vector transmission by flies sitting on excreta and cross contamination (14,20,22).

Vibrio cholerae transmitted by direct contact with hands and clothing soiled with the excreta of a diseased person, ingestion of polluted and contaminated water, food and aerated water, contaminated equipment and vector transmission by house flies. It is therefore should be splitted, washed and leaves should be drained well (14).

Salmonella group C was isolated in step 1 of cabbage preparation. *Salmonella spp.* could be introduced by food handle and cross contamination between ready to eat and raw material. The possible ways of contamination include direct contamination of the pre-harvested fruits or vegetables from faeces of animals, the use of sewage or manure as fertilizer and the use of contaminated waters for irrigation of the crops (23,39,40,41).

Salmonella group E was isolated in step 2: after putting in water in barley preparation. The possibility of Salmonella contamination was from direct contact of sick food-handler, cross contamination, if the food handler didn't wash hand after using the toilet or vector transmission by rodents and flies from faecal matter (23).

Healthy humans are known to be a potential source of *Staphylococcus aureus*. This potential source is available throughout the working hours of the food handler. Every time food handler's hands make contact with body parts harboring the staphylococci, they become contaminated, and subsequently contaminate food they touch. Direct transfer of these cocci from the respiratory tract to food is made when the food worker coughs and sneezes without covering their nose and mouth, they serve as a vehicle of transmission for many foods (27).

High temperatures will destroy most of harmful bacteria and relatively few exceptions, cooking plant food.

The microbiological quality of mayonnaise showed that the number of coliform bacteria, *E.coli*, yeast and mold was in the acceptable level of the microbiological standard of the Department of Medical Science. Also the number of food-borne pathogens was not detected in any step of preparation. The pH of mayonnaise dressing as shown in appendix C was 4.5. A pH of 4.5 is the approximate level below which little multiplication need be expected of bacteria which are capable of causing food-borne gastroenteric outbreaks. A pH 4.5 indicates a fairly acid condition. Fruits and vegetables, pickles, relishes and vinegar can be combined with non-acid ingredients into mixtures that are of low pH and are poor supporters of bacterial growth (27). Only a small range of microorganisms survive and cause spoilage in this type of mayonnaise due to its acid pH and low water content (42). Acid salad dressing, mayonnaise may contribute some preservative effect to food due to its relatively low pH. The major contributors of anti-microbial properties to mayonnaise anti-microbial properties are the concentration of acetic acid from vinegar and the low pH of salad dressing (23,43).

The result supported the survey study of Vanessa *et.al* (4) this survey indicated that the pH range for krab salad could support growth of pathogenic microorganisms.

5.1.2 Salad bar in supermarket

Microbiological contaminations of fresh and boiled ingredient preparation from salad bar in supermarket showed that almost all of raw ingredients: lettuce, cantaloupe, baby corn, taro, pumpkin, cauliflower, white radish and asparagus had high contamination of coliform bacteria and *E.coli*. The contamination was higher than the microbiological standard of the Department of Medical Science, eventhough all vegetables at the supermarket are certified by the Department of Agriculture.

Although the supermarket companies pay attention and concern about food safety, microbiological contamination was still found in raw ingredients. However, they focus mostly on chemical contaminants in vegetables, whereas raw fruits and vegetables can be contaminated in the production process. Products such as lettuce and cabbage, usually grow on the ground, where they likely to be contact with contaminated fertilizers or contaminated waters or poor hygienic practice of the pickers (38).

The results illustrated that the cleaning and boiling step are the Critical Control Points (CCPs) of salad preparation steps because the methods can reduce microbiological contamination to the acceptable levels.

There was no growth of pathogenic organisms in any steps of salad preparation because the personnel who prepared salad ingredients knew and concern hygienic practices of food preparation such as keeping equipment and places clean, wearing uniform (hair net and apron) and keeping their hand clean.

The result of microbial determination of canned ingredients showed that there was not any pathogenic organisms, coliform, *E.coli*, yeast and mold because all canned ingredients are sterilized and approved by Food and Drug Administration of Thailand. Many food processing technologies based on heat treatment, such as canning and pasteurization, effectively control microbial hazards in foods and render them safe if applied properly (44).

Microbial contamination of potato salad, coleslaw and apple salad was not found at any steps of preparation which was similar to that of canned ingredient. It is because potato salad, coleslaw and apple salad were mixed with mayonnaise salad dressing which had low pH-that would not support the growth of food-borne pathogens (23)- and they also discard leftovers that displayed longer than 2 hrs.

The study of Jongkeartcharoen P (29) about the Critical Control Point about Biological Hazards for vegetable salad preparation in supermarket found that *S.aureus* was detected 10% of samples, eventually *Salmonella spp*. was not detected. Eventhough the results of salad bar in supermarket found that there was no growth of food borne pathogens in any steps of salad ingredients that were not supported the study of Jongkeartcharoen P. may be because of studying in different supermarket and unsuitable hygienic practices for salad preparation and a lack of basic knowledge regarding food handling.

5.2 Displaying practice

5.2.1 Salad sold by street vendor

After finishing preparation, salad ingredients were brought to display and sell. The results of microbiological contamination clearly showed that the number of microorganisms increased during the time of salad displaying while salad was sold for a long period, it was often kept at ambient temperature that could permit microbiological growth.

If microorganisms are in a favorable environment in terms of temperature, moisture and nourishment, they would rapidly multiply to a high number that can harm in a short time. A small number of pathogenic microorganisms in food can multiply rapidly and causes illness after consumption.

Staphylococcus aureus was found in barley during displaying. Salad ingredients were exposed to many sources of contamination bacteria such as improper handling: used one ladle for several ingredients, vector, dust or droplets from nose, sneezed or coughed from vendor or consumer (14).

The results supported the study of P. Viswanathan and R. Kaur (2) about prevalence and growth of pathogens on salad vegetables, fruit and sprouts. The study revealed the potential hazard of street vendor salad vegetables, fruit and sprouts. The growth pattern of microorganisms on vegetables and fruits which studied at room temperature (32^{o}c), supported the possibility of high numbers of *Staphylococcus aureus* and *Salmonella typhi* developing on cut salad vegetables and fruits in sufficient time and appropriate temperature.

Health risks are associated with initial contamination and subsequent contamination by street vendors during handling and microbial proliferation during displaying (2). Food hygienic practice of street vendors can be the main source of microbiological contamination.

5.2.2 Salad bar in supermarket

The results showed that the number of coliform bacteria, *E.coli*, yeast and mold at displaying step was slightly higher than the previous steps at the acceptable level of the microbiological standard of the Department of Medical Science. The food ingredients which were displayed at self-service salad bar may be an additional risk of being contaminated by the patronizing customers. The sources of

contamination could be not enough tongs ladles or coughing, or sneezing or touching the salad ingredients by customers during displaying.

During transportation and distribution there are additional opportunities for growth of microorganisms which are present in the food, and for cross-contamination between foodstuffs. Time-temperature abuse of foods is also a common occurrence that may lead to in creased levels of pathogens (45,46).

Normally, the amount of microbiological indicators after 2 hrs but not more than 3 hrs of displaying should be more than during the first displaying. However in some salad ingredients the amount of microbiological indicators after 2 hrs but not more than 3 hrs of display was less than during the first displaying. This may be result from the random sampling during laboratory operation or during step of microbiological identification.

5.3 Determination of Critical Control Points (CCPs)

According to the result from using Decision Tree of salad sold by street vendor concluded that cleaning, slicing, cutting and displaying steps are the Critical Control Points (CCPs) of cucumber, lettuce, tomato, onion, carrot, cabbage and pineapple preparation; boiling, cleaning and displaying are the Critical Control Points (CCPs) of red kidney bean, boiled egg, barley, boiled sweet potato and corn; however, there are no Critical Control Points in mayonnaise preparation.

According to the result from using Decision Tree of salad bar in supermarket concluded that cleaning, slicing and displaying steps are the Critical Control Points (CCPs) of cucumber, tomato and onion preparations; thus cleaning and displaying steps are the Critical Control Points (CCPs) of red cabbage, cabbage and carrot preparations. The boiling and displaying steps are the Critical Control Points (CCPs) of baby corn, asparagus, taro, pumpkin and mixed vegetables; whereas the cleaning, boiling and displaying steps are the Critical Control Points (CCPs) of potato and potato salad preparation; cleaning and displaying steps are the Critical Control Points (CCPs) of coleslaw preparation and canned ingredients.

5.3.1 Critical Control Points (CCPs)

Slicing, cutting

If slicing or cutting are the last step before displaying, both of these steps can be the critical control point. The salad ingredients might be contaminated during these preparation steps via knife, chopping block or personal practices. So microorganisms can growth and harmful.

Cleaning

Raw materials of salad ingredients are contaminated with microorganisms during distribution but after they were cleaned, the amount of microbiological hazards was reduced to an acceptable level. However, cleaning can reduce microbiological quantity by using clean water, if not it would be encourage the growth of microorganisms.

Boiling

Boiling is the important step of salad preparation as well, that can reduce and eliminate microbiological quality to an acceptable. Hot temperatures will kill most harmful bacteria and with relatively few exceptions, such as cooking plant foods. This is a critical control point (CCP). It is at this step that food will be made safe to eat(10).

Displaying

Displaying at ambient temperature without contamination protection caused contamination that can contaminate via environmental, consumer and personal practice. The microorganisms would have multiplied to numbers large enough to cause harm.

CHAPTER VI
CONCLUSION AND SUGGESTION

6.1 Conclusion

This study was designed to analyze the microbiological hazards and to determine the Critical Control Points (CCPs) of salads sold by a street vendor and salad bar in a supermarket by observing salad preparations and displaying practices, collecting samples during each step of salad and mayonnaise preparations and time of salad displaying then determined the Critical Control Points (CCPs). The results showed that 7 of 12 ingredients of salad sold by a street vendor which the amount of microbiological hazards was higher than the standard of the Department of Medical Science were cucumber; coliform bacteria and yeast in raw material, lettuce; coliform bacteria in any steps exclude step after cleaning, *E.coli* in raw material, yeast in raw material and displaying step, *Clostridium perfringens* and *Vibrio cholerae* in raw material, cabbage; coliform bacteria in displaying step, *E.coli* in raw material and displaying step and *Salmonella spp*. in raw material, red kidney bean; coliform bacteria in displaying step, barley; coliform bacteria and *E.coli* in displaying step, *Salmonella spp*. in step after putting in water and *Staphylococcus aureus* in displaying step, boiled sweet potato and corn; coliform bacteria and *E.coli* in raw material and displaying step, yeast in raw material. The results of salad bar in a supermarket showed that 14 of 23 ingredients that the amount of microbiological hazards was higher than the standard of the Department of Medical Science were tomato; coliform bacteria in displaying step, lettuce; coliform bacteria in raw material and step after cutting, *E.coli* in raw material and displaying step and yeast in raw material and step after cutting, cantaloupe; coliform bacteria and *E.coli* in raw material, red cabbage and cabbage; in raw material and step after slicing, carrot; in raw material and step after cutting, baby corn; coliform bacteria in raw material and step after cutting, *E.coli* in step after cutting, asparagus; *E.coli* in raw material, yeast in raw material and step after cutting, potato; *E.coli* in step after putting in water, yeast in raw material and in step after cutting, taro; coliform bacteria and yeast in raw material and step after

putting in water, pumpkin; coliform bacteria and yeast in raw material, mixed vegetable; coliform bacteria and yeast in raw material and step after cutting, potato salad; *E.coli* in step after putting in water and coleslaw; in raw material, step after putting in water and displaying step.

After finishing preparation, salad ingredients were brought to display and sell. The results of microbiological contamination clearly showed that the number of microbiological hazards increased during the time of salad displaying.

According to the result of study, the microbiological indicators of salad preparation sold by street vendor showed that raw fresh ingredients: cucumber, lettuce, tomato, onion, carrot, cabbage and pineapple were sometimes highly contaminated by coliform bacteria, *E.coli*, *Salmonella spp*. *Vibrio cholerae* and *Clostridium perfringen* during preparation. However, the microbial were reduced to the acceptable level after cleaning and washing. It can be concluded that cleaning, slicing, cutting and displaying steps are Critical Control Point for fresh ingredient preparation as the step can minimize the microbes to the safety level.

The result of microbiological indicators of the boiled ingredients; red kidney bean, boiled egg, barley, boiled sweet potato and corn showed that raw potatoes were contaminated by coliform bacteria, *E.coli*, yeast and mold. After they were boiled at high temperature, the microbes were killed and reduced to the acceptable level. In conclusion the boiling, cleaning and displaying steps are the Critical Control Point for boiled ingredient preparation. There is no Critical Control Point for mayonnaise dressing preparation since the acidity property of the products.

According to the result of study, the microbiological indicators of salad preparation that sold in supermarket showed that raw fresh ingredients; cucumber, tomato, onion, lettuce, pineapple, cantaloupe, red cabbage, cabbage and carrot were contaminated by coliform bacteria, *E.coli*, yeast and mold. Only coliform bacteria, which was found in raw lettuce, was higher than the microbiological standard of the Department of Medical Science.

However, after cleaning the bacteria were reduced to the acceptable level. In conclusion the cleaning, slicing and displaying steps are the Critical Control Points (CCPs) of cucumber, tomato and onion preparations, while cutting and displaying

steps are the Critical Control Points (CCPs) of pineapple and cantaloupe preparations thus cleaning and displaying steps are the Critical Control Points (CCPs) of lettuce, red cabbage, cabbage and carrot preparations.

The result of microbiological indicators of the boiled ingredients; baby corn, asparagus, potato, taro, pumpkin and mixed vegetable, the microbiological indicators showed that raw ingredients of the preparation steps of baby corn and taro were contaminated by coliform bacteria and *E.coli* as well as raw ingredients of mixed vegetables were contaminated by coliform bacteria, yeast and mold. While raw ingredients of asparagus were contaminated by only *E.coli*. After they were boiled at high temperature, the microbes were killed and reduced to the acceptable level. In conclusion, the boiling and displaying steps excluded potato preparations, The Critical Control Points (CCPs) are the cleaning, boiling and displaying steps.

The miscellaneous ingredients of salad consisted of potato salad, coleslaw, apple salad, red kidney bean, jelly, garden pea, corn and water nut. The microbiological indicator of potato salad preparation steps showed that potato salad were contaminated during preparation by coliform bacteria, *E.coli*, yeast and mold. *E.coli* was only found in the steps before cleaning raw ingredient and after peeling. The number of microbe was higher than the microbiological standard of the Department of Medical Science. However after cleaning and boiling, *E.coli* was minimized to the acceptable level. It is therefore cleaning and boiling and displaying steps are the Critical Control Points (CCPs) of potato salad preparation.

Due to the result of the microbiological indicator of apple salad preparation the study showed that apple salad were contaminated during preparation by coliform bacteria, E.coli, yeast and mold. However the number of microbial contamination were at the acceptable levels. It can be concluded that the cleaning and displaying steps are the Critical Control Point of apple salad.

The microbiological indicator results of coleslaw preparation steps comparing to the microbiological standard of the Department of Medical Science showed that potato salad were contaminated during preparation by coliform bacteria, *E.coli*, yeast and mold. However only yeast was found in raw and shredded cabbage at higher level than the microbiological standard of the Department of Medical Science. The number of yeast was reduced to the acceptable level after it was kept in the refrigerator. In

addition, the result of Decision tree recommended by World Health Organization showed that only the displaying step is the Critical Control Points (CCPs) of coleslaw preparation.

The result of the microbiological indicator of canned ingredients, jelly, garden pea, corn and water nut showed that coliform bacteria, *E.coli*, yeast and mold were found during preparation at the acceptable levels. The results of Decision tree recommended by World Health Organization showed that only the displaying step is the Critical Control Points (CCPs) of canned ingredients.

6.2 Suggestion (47,48,49,50,51,52,53,54,55,56,57,58,59,60)

Suggestion for application

According to the result of study, it is suggested that improving of safety and hygienic preparation could reduce microbiological contamination as following:

- Buy food from reliable and approved suppliers.
- Store ready to eat food at proper temperature and separate away from raw foods.
- Keep storage area clean and hygienic.
- Wash and clean raw fruits and vegetables thoroughly.
- Use separate knife and cutting boards for ready to eat food and raw food.
- Protect and cover foods from contamination while transporting to display counters.
- Display food in small portions in a short display time (Avoid placing food at room temperature for more than 2 hours)
- Avoid direct contact of bare hand with cooked food. Use utensil or equipment to pick up food. One kind of utensil can only use with one type of food.
- The Food handlers should have good personal hygiene and practices during preparing and selling food.

Research methodology suggestion

- This research studied about the potential microbiological hazards and critical control points of salads sold by a street vendor and salad bar in a supermarket that studied on selected salad sellers so the amount of microbiological hazards results together with the critical control points were focus on only both salad sellers.

Suggestions for further studies:

- Critical Control Points of preparation step of salad bar in supermarket by comparing between different supermarkets and how to implement Hazard Analysis Critical Control Point in steps of salad preparation.
- Critical Control Points of salad preparation sold by street vendor by comparing in different food sellers and places and how to implement Hazard Analysis Critical Control Point in steps of salad preparation.

Recommendation for application:

- How to implement Hazard Analysis Critical Control Point in steps of salad preparation both salad sold by street vendor and salad bar in supermarket.

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APPENDIX

Appendix A

The microbiological standard of the Department of Medical Science

Type of food	Microbiological indicators	Standard
Ready to eat		
Rinsed fruit,	Yeast / g	Less than $1x10^4$
vegetable, salads,	Mold / g	Less than 500
papaya salads	MPN *E.coli* / g	Less than 10
	Salmonella / 25 g	Not found
Food contact surface		
Equipment for	Total plate count (g / piece)	Less than $1x10^3$
consumed food such		
as fork, spoon		

Appendix B

Modified method from Food and Drug Administration (FDA)

Bacteriological Analytical

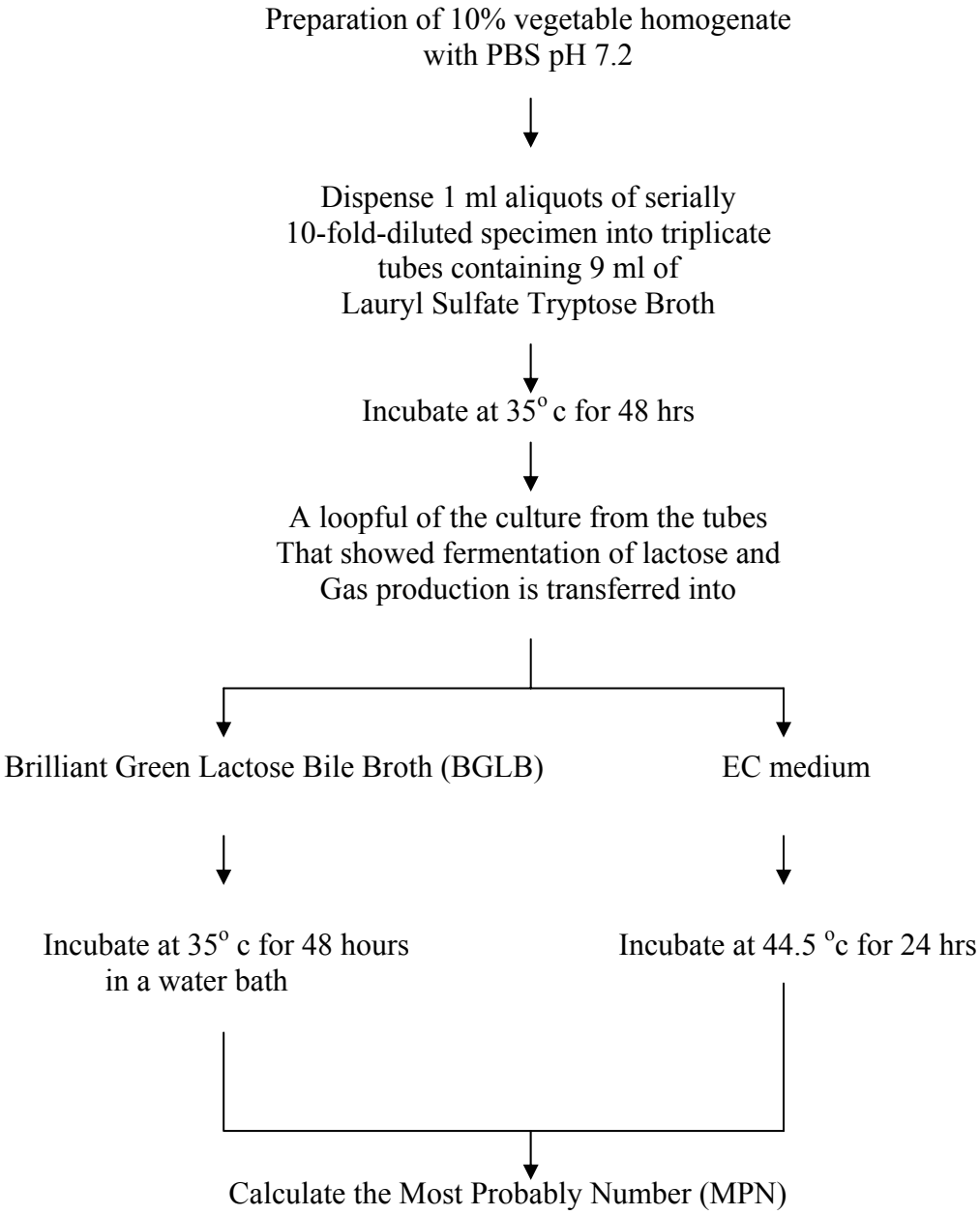


Figure B-1 Most Probably Number technique for the enumeration of coliform bacteria and *E.coli*

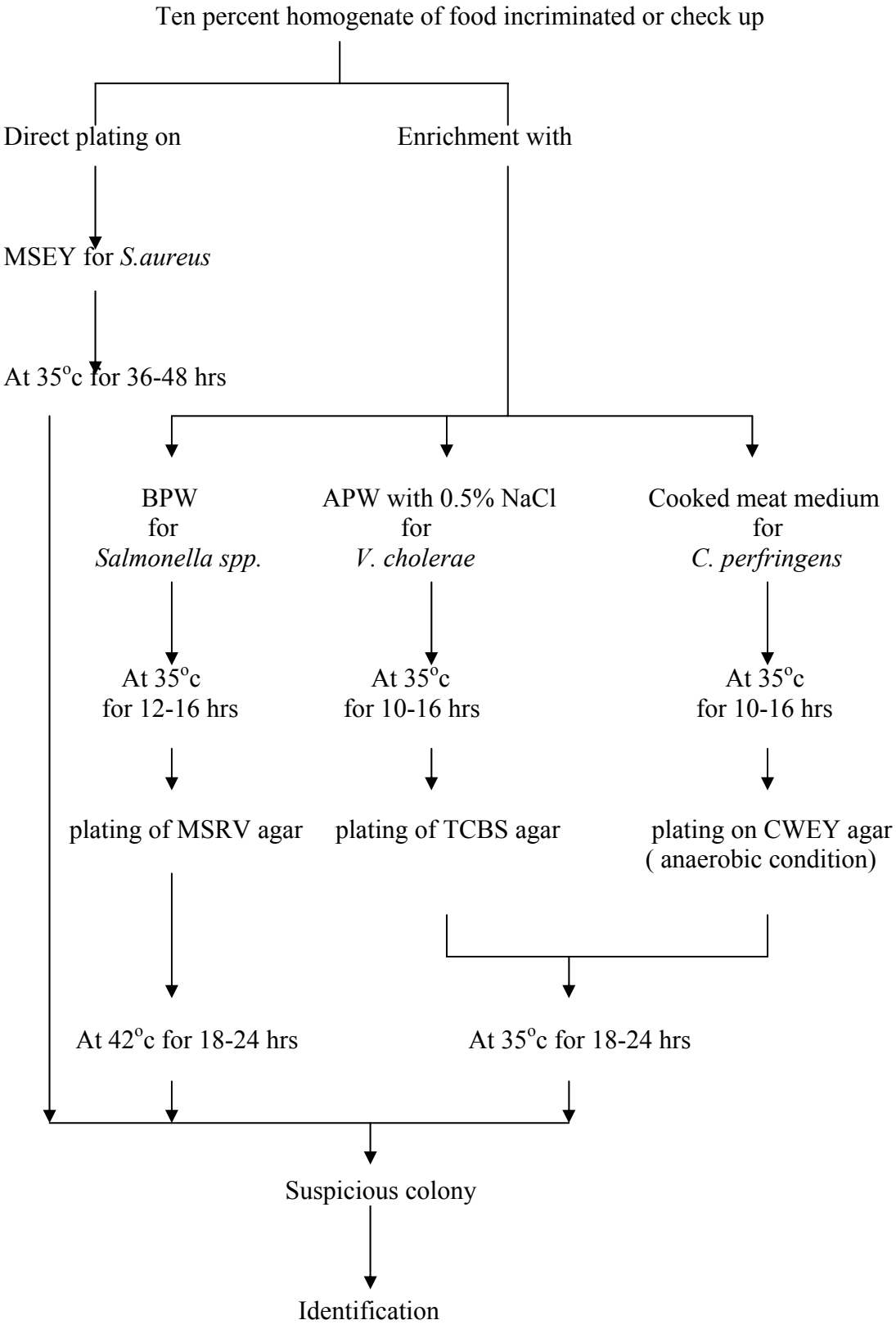


Figure B-2 Isolation of food- borne organisms from food incriminated as vehicle.

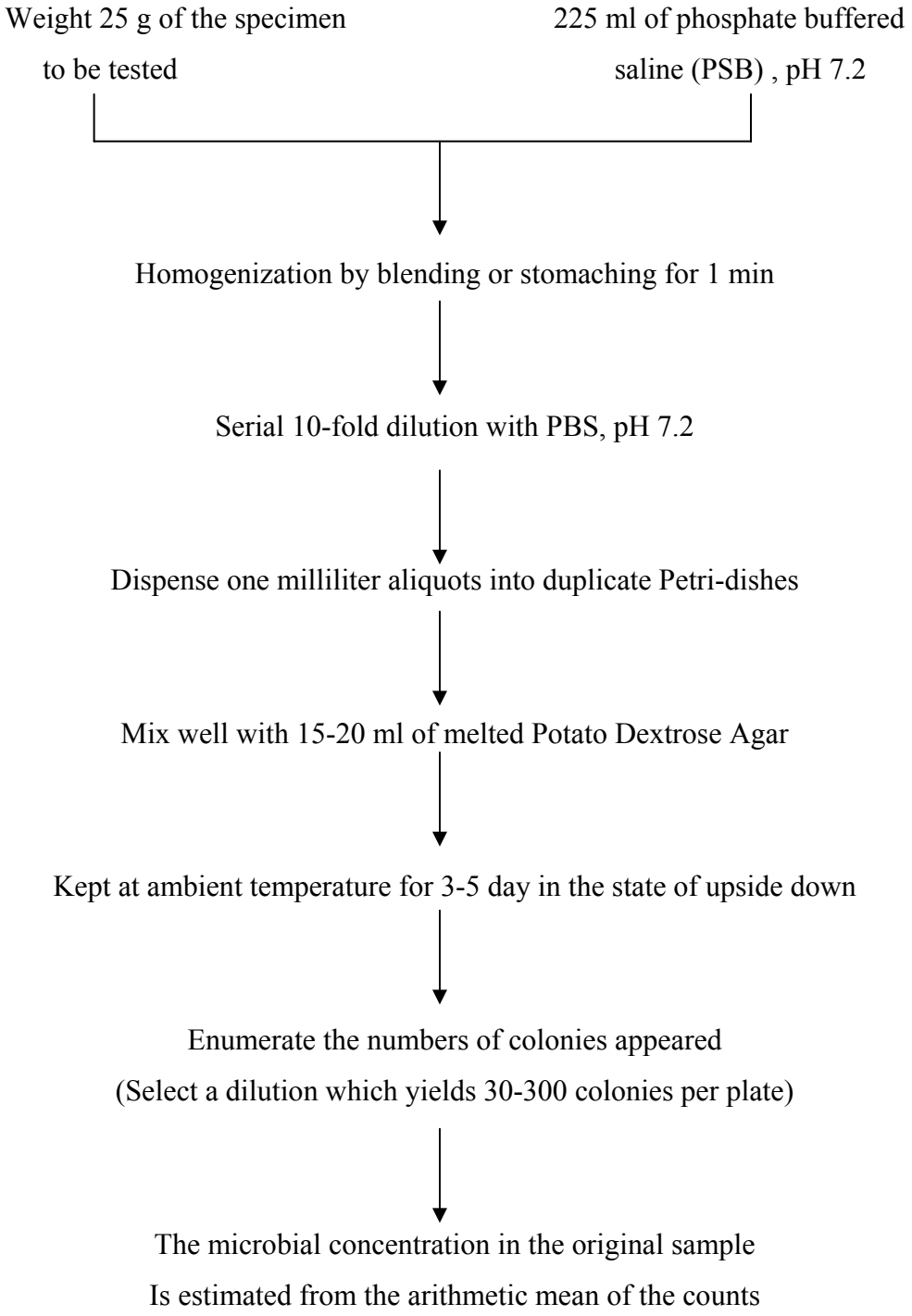


Figure B-3 Plate count of yeast and mold

Appendix C

Food Sanitation Checklist.

Temperature of preparing condition.

Salad sold by street vendor	ambient temperature
Salad bar in supermarket	25 ^{o}C

Temperature of displaying condition.

Salad sold by street vendor	ambient temperature
Salad bar in supermarket	12 ^{o}C

pH of mayonnaise dressing

Salad sold by street vendor	4.5

Refrigeration

- Are cooked foods kept apart from raw foods?
- Are all parts of the refrigerator easily accessible for cleaning?
- Are all foods covered to product them from contamination?
- Are opened can of food stored in the refrigerator?

Food preparation and handling practices

- Is any cleaning operation like sweeping or dusting carried out during food preparation or service?
- Are fruits, vegetables, grains, etc. washed thoroughly before preparation?
- Are foodstuffs or utensils containing food placed on the floor?
- Are kitchen sinks used for employee hand washing or for emptying mop water?
- Are all parts of the equipment kept clean, for example drip trays?
- Are food sinks used for dishwashing?
- Are sharp equipment like knives, peelers, etc cleaned well before keeping them away?
- Is equipment cleaned between changed use?
- Are chopping block in good condition no splits, cuts or holes?
- Are chopping block cleaned and sanitized between changed use?
- Is the floor of the kitchen and other food preparation areas clean and dry?
- Are all prepared food items kept covered?

Service

- Is any dust visible in the service areas?

Waste disposal

- Are garbage containers adequate in number and size?
- Are they covered and in a good state of repair?

Pest control

- Are any pests visible in or around the establishment?
- Are there any signs of pest infestation (droppings, eggs, marks, etc)in the premises?

Personal practices

- Are the hands of food handlers washed clean at the start of the day and whenever required?
- Are the hands of food handlers clean and free from cracks?
- Do any food handlers have infected cuts, burns, boils, etc?
- Are food handlers observed picking nose or pimples, scratching head or face?
- Are hands washed after blowing the nose and coughing even when a handkerchief is used?
- Are adequate hand washing facilities provided?
- Are fingernails clean, trimmed and unvarnished?
- Are all employee in uniform?
- Are uniforms/ outer garments clean?
- Is hair covered by a cap, hair net or scarf (any hair restraint)?
- Are any food handlers suffering from or just recovered from any contagious or food borne disease?
- Are hands washed in sinks used for food preparation?
- Do food handlers wear wrist watches, dangling bracelets, bangles, earrings or any other jewelry?

Construction

- Are there any depressions and low areas on floors and work surfaces?
- Are walls near cooking and wash-up area adequately tiled?
- Are all tiled areas and wall clean?
- Are floors durable, imperious and easy to clean?

Appendix D

Microbiological indicator results of salads sold by a street vendor and salad bar in a supermarket

1st LABORATORY RESULT

Remarks :

S.a *Staphylococcus aureus*

Sal *Salmonella spp.*

V.c *Vibrio cholerae*

C.p *Clostridium perfringens*

STREET VENDOR SALADS

Cucumber

❶ ❷ ❸ ❹ ❺ ❻

→ Peeling→ cleaning → slicing → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	1,100.0	<3	250	<10	-	-	-	-
❷	<3	<3	20	<10	-	-	-	-
❸	<3	<3	20	<10	-	-	-	-
❹	<3	<3	10	<10	-	-	-	-
❺	3.6	<3	130	<10	-	-	-	-
❻	15.0	<3	650	<10	-	-	-	-

Lettuce

❶ ❷ ❸ ❹ ❺ ❻

→ Plucking leave → cleaning → cutting → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	>1,100	34.0	$2.0x10^3$	10	-	-	-	+
❷	>1,100	28.0	150	<10	-	-	-	-
❸	290.0	3.0	20	<10	-	-	-	-
❹	>1,100	15.0	40	<10	-	-	-	-
❺	>1,100	16.0	180	<10	-	-	-	-
❻	>1,100	290.0	220	<10	-	-	-	-

Tomato

❶ ❷ ❸ ❹
→ Cleaning → slicing → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	>1,100	<3	<10	<10	-	-	-	-
❷	23.0	<3	10	<10	-	-	-	-
❸	93.0	<3	<10	10	-	-	-	-
❹	>1,100	3.6	$1x10^4$	20	-	-	-	-

Onion

❶ ❷ ❸ ❹ ❺
→ Peeling → cleaning → slicing → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	10	10	-	-	-	-
❷	<3	<3	10	<10	-	-	-	-
❸	28.0	<3	30	<10	-	-	-	-
❹	43.0	<3	<10	<10	-	-	-	-
❺	93.0	<3	10	<10	-	-	-	-

Carrot

❶ ❷ ❸ ❹ ❺
→ Peeling → cleaning → shredding → cleaning → displaying →

❻
after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	$2.0x10^3$	20	-	-	-	-
❷	<3	<3	20	<10	-	-	-	-
❸	<3	<3	10	<10	-	-	-	-
❹	3.6	3.6	150	<10	-	-	-	-
❺	39.0	39.0	100	<10	-	-	-	-
❻	93.0	21.0	250	<10	-	-	-	-

Red kidney bean

❶ ❷ ❸ ❹ ❺
→ Putting in water→ boiling→ displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	150	20	-	-	-	-
❷	43.0	<3	100	<10	-	-	-	-
❸	<3	<3	50	<10	-	-	-	-
❹	460.0	<3	$1.0x10^3$	50	-	-	-	-
❺	>1,100	<3	$2.0x10^3$	30	-	-	-	-

Boiled egg

❶ ❷ ❸
→ Boiling→ peeling → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	<10	<10	-	-	-	-
❷	<3	<3	<10	<10	-	-	-	-
❸	53.0	11	<10	<10	-	-	-	-

Cabbage

❶ ❷ ❸ ❹ ❺
→ Peeling → shredding → putting in hard water → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	460.0	43.0	<10	<10	-	**c**	-	-
❷	460.0	<3	<10	<10	-	-	-	-
❸	290.0	<3	<10	<10	-	-	-	-
❹	>1,100	14.0	<10	<10	-	-	-	-
❺	>1,100	36.0	<10	<10	-	-	-	-

Pineapple

❶ ❷ ❸ ❹ ❺ ❻
→ Peeling → cleaning → cutting → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	460.0	<3	$2.0x10^4$	10	-	-	-	-
❷	<3	<3	<10	<10	-	-	-	-
❸	<3	<3	<10	<10	-	-	-	-
❹	<3	<3	<10	<10	-	-	-	-
❺	23.0	<3	<10	<10	-	-	-	-
❻	460.0	43.0	20	<10	-	-	-	-

Barley

❶ ❷ ❸ ❹ ❺
→ Putting in water → boiling → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	<10	<10	-	-	-	-
❷	<3	<3	<10	<10	-	**E**	-	-
❸	<3	<3	<10	<10	-	-	-	-
❹	36.0	<3	<10	<10	-	-	-	-
❺	>1,100	11.0	<10	<10	-	-	-	-

Boiled sweet potato

❶ ❷ ❸ ❹ ❺
→ Peeling → cutting → cleaning → boiling → displaying

❻
→ after displaying 2 hrs

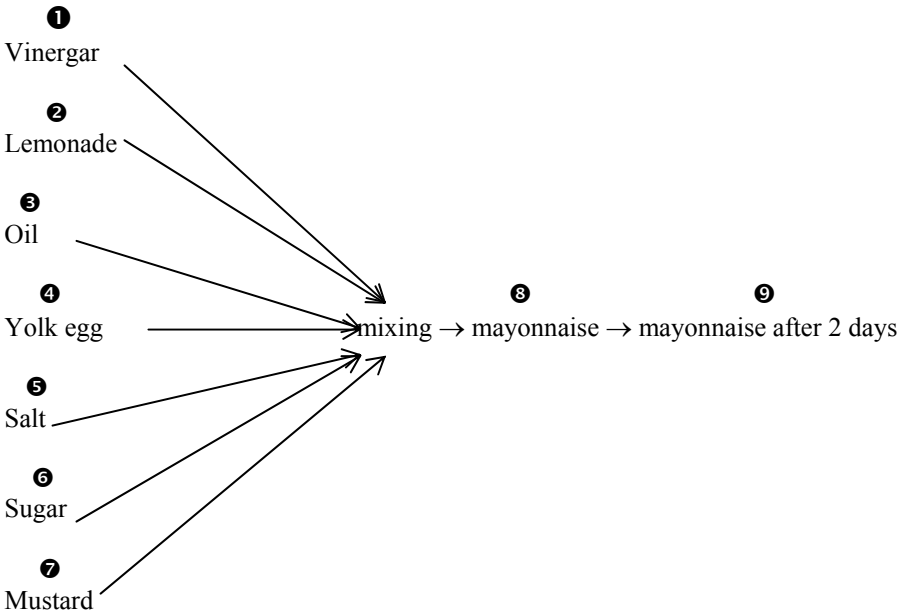
	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	>1,100	150.0	$6.3x10^4$	30	-	-	-	-
❷	150.0	14.0	650	10	-	-	-	-
❸	6.1	<3	350	<10	-	-	-	-
❹	<3	<3	<10	<10	-	-	-	-
❺	150.0	11	300	<10	-	-	-	-
❻	>1,100	53	350	<10	-	-	-	-

Corn

❶ ❷ ❸ ❹
→ Boiling → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	>1,100	1,100.0	$6.5x10^5$	<10	-	-	-	-
❷	<3	<3	<10	<10	-	-	-	-
❸	150.0	3.0	20	<10	-	-	-	-
❹	>1,100	>1,100	50	20	-	-	-	-

Mayonnaise dressing



	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	<10	<10	-	-	-	-
❷	<3	<3	<10	<10	-	-	-	-
❸	<3	<3	<10	<10	-	-	-	-
❹	<3	<3	<10	<10	-	-	-	-
❺	<3	<3	<10	<10	-	-	-	-
❻	<3	<3	<10	<10	-	-	-	-
❼	<3	<3	<10	<10	-	-	-	-
❽	<3	<3	<10	<10	-	-	-	-
❾	<3	<3	<10	<10	-	-	-	-

Salad bar in supermarket

Cucumber

❶ ❷ ❸ ❹ ❺
→ Peeling → cleaning → slicing → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	<10	<10	-	-	-	-
❷	<3	<3	<10	<10	-	-	-	-
❸	3.6	<3	80	<10	-	-	-	-
❹	15.0	<3	<10	<10	-	-	-	-
❺	23.0	<3	<10	<10	-	-	-	-

Water nut

❶ ❷
Decaning → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	<10	<10	-	-	-	-
❷	<3	<3	<10	<10	-	-	-	-

Corn

❶ ❷
Decaning → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	<10	<10	-	-	-	-
❷	<3	<3	<10	<10	-	-	-	-

Garden pea

❶ ❷
Decaning → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	<10	<10	-	-	-	-
❷	<3	<3	<10	<10	-	-	-	-

Tomato

❶ ❷ ❸ ❹
→ Cleaning → slicing → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	9.1	<3	10	<10	-	-	-	-
❷	<3	<3	<10	<10	-	-	-	-
❸	23.0	<3	<10	<10	-	-	-	-
❹	>1,100	<3	<10	<10	-	-	-	-

Onion

❶ ❷ ❸ ❹ ❺
→ Peeling → cleaning → slicing → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	15.0	<3	$2.0x10^3$	10	-	-	-	-
❷	<3	<3	120	<10	-	-	-	-
❸	<3	<3	20	<10	-	-	-	-
❹	<3	<3	210	20	-	-	-	-
❺	9.1	<3	$7.2 x10^3$	30	-	-	-	-

Jelly

❶ ❷
Decaning → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	<10	<10	-	-	-	-
❷	<3	<3	<10	<10	-	-	-	-

Baby corn

❶ ❷ ❸ ❹
→ Cutting → boiling → putting in water → dewatering → displaying

❺
→ After displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	>1,100	3.6	$3.2x10^3$	<10	-	-	-	-
❷	>1,100	11.0	$4.7x10^3$	<10	-	-	-	-
❸	<3	<3	<10	<10	-	-	-	-
❹	<3	<3	<10	<10	-	-	-	-
❺	<3	<3	<10	<10	-	-	-	-

Lettuce

❶ ❷ ❸ ❹
→ Cutting → cleaning → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	1,100.0	210.0	$2.5x10^5$	10	-	-	-	-
❷	1,100.0	16.0	$1.0x10^5$	<10	-	-	-	-
❸	3.6	<3	100	<10	-	-	-	-
❹	15.0	<3	150	30	-	-	-	-

Red kidney bean

❶ ❷
Decaning → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	<10	<10	-	-	-	-
❷	3.0	<3	<10	<10	-	-	-	-

Asparagus

❶ ❷ ❸ ❹
→ Cutting → boiling → putting in water → dewatering → displaying

❺
→ After displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	240	93	$3.0x10^4$	<10	-	-	-	-
❷	210	<3	$4.2x10^4$	<10	-	-	-	-
❸	<3	<3	<10	<10	-	-	-	-
❹	<3	<3	<10	<10	-	-	-	-
❺	7.3	<3	<10	<10	-	-	-	-

Pineapple

❶ ❷ ❸
→ Peeling → cutting → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	93.0	<3	30	30	-	-	-	-
❷	<3	<3	20	<10	-	-	-	-
❸	<3	<3	20	10	-	-	-	-

Cantaloupe

❶ ❷ ❸
→ Peeling → cutting → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	>1,100	35.0	10	<10	-	-	-	-
❷	<3	<3	<10	<10	-	-	-	-
❸	9.3	<3	<10	<10	-	-	-	-

Apple salad

❶ ❷ ❸ ❹
→ Cutting → cleaning → mayonnaise → mixing → displaying

❺
→ after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	15.0	<3	<10	<10	-	-	-	-
❷	<3	<3	<10	<10	-	-	-	-
❸	<3	<3	100	10	-	-	-	-
❹	<3	<3	150	<10	-	-	-	-
❺	<3	<3	100	<10	-	-	-	-

Red cabbage

❶ ❷ ❸ ❹ ❺
→ shredding→ keeping in fridge→ cleaning → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	15	<3	$5.0x10^4$	30	-	-	-	-
❷	9.1	<3	$4.0x10^4$	30	-	-	-	-
❸	150	<3	170	20	-	-	-	-
❹	44	<3	100	<10	-	-	-	-
❺	210	<3	200	10	-	-	-	-

Cabbage

❶ ❷ ❸ ❹ ❺
→ shredding→ keeping in fridge → cleaning → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	$1.8x10^5$	40	-	-	-	-
❷	3.6	<3	$1.5x10^5$	20	-	-	-	-
❸	<3	<3	180	10	-	-	-	-
❹	<3	<3	150	20	-	-	-	-
❺	15	<3	210	30	-	-	-	-

Potato

❶ ❷ ❸
→ Peeling → cutting → putting in water→ keeping in fridge → cleaning

❹ ❺ ❻
→ boiling → Displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	$1.2x10^4$	20	-	-	-	-
❷	75.0	3	$3.0 x10^4$	20	-	-	-	-
❸	93.0	43	$2.8 x10^3$	10	-	-	-	-
❹	7.3	3.6	400	<10	-	-	-	-
❺	<3	<3	10	<10	-	-	-	-
❻	3.6	<3	50	20	-	-	-	-

Taro

❶ ❷ ❸ ❹
→ Peeling→ cutting → putting in water→ boiling → displaying

❺
→ After displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	>1,100	23	$5.0x10^4$	<10	-	-	-	-
❷	9.1	<3	$4.0 x10^4$	<10	-	-	-	-
❸	>1,100	<3	$4.0 x10^3$	<10	-	-	-	-
❹	<3	<3	<10	<10	-	-	-	-
❺	3.6	<3	20	<10	-	-	-	-

Coleslow

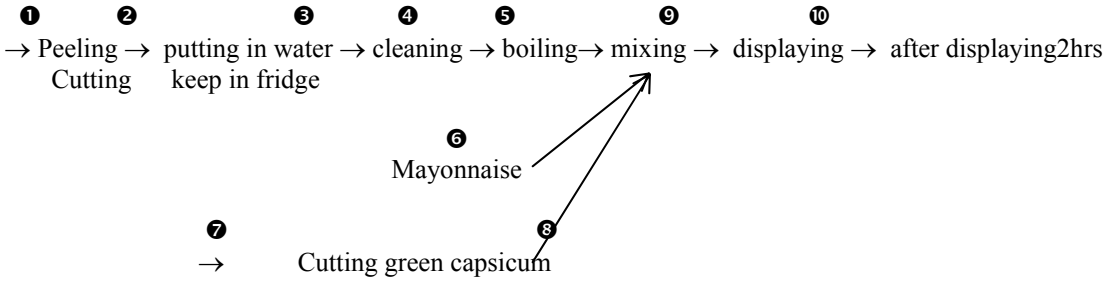
❶ ❷ ❸
→ Peeling and shredding carrot → keeping in fridge

❹ ❺ ❻ ❽ ❾
→ Peeling and shredding cabbage→ keeping in fridge → mixing→ displaying → after displaying2hrs

❼
mayonnaise

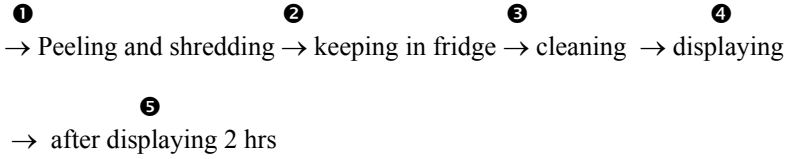
	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	23.0	<3	$5.7x10^4$	10	-	-	-	-
❷	3.6	<3	110	<10	-	-	-	-
❸	3.6	<3	20	<10	-	-	-	-
❹	<3	<3	$1.8x10^5$	<10	-	-	-	-
❺	3.6	<3	$1.5 x10^5$	<10	-	-	-	-
❻	120.0	<3	$4.0 x10^3$	10	-	-	-	-
❼	<3	<3	100	<10	-	-	-	-
❽	210.0	<3	$3.2x10^3$	<10	-	-	-	-
❾	240.0	<3	$4.0 x10^3$	<10	-	-	-	-

Potato salad



	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	$1.2x10^3$	100	-	-	-	-
❷	75.0	3.0	150	10	-	-	-	-
❸	93.0	43.0	200	<10	-	-	-	-
❹	7.3	3.6	50	<10	-	-	-	-
❺	<3	<3	<10	<10	-	-	-	-
❻	<3	<3	100	<10	-	-	-	-
❼	<3	<3	<10	<10	-	-	-	-
❽	<3	<3	<10	<10	-	-	-	-
❾	120.0	<3	250	20	-	-	-	-
❿	460.0	<3	$3x10^3$	30	-	-	-	-

Carrot



	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	23.0	<3	$5.7x10^4$	20	-	-	-	-
❷	3.6	<3	$1.1 x10^5$	10	-	-	-	-
❸	3.6	<3	$6.0 x10^3$	20	-	-	-	-
❹	15.0	<3	150	<10	-	-	-	-
❺	75.0	<3	$1.2 x10^3$	<10	-	-	-	-

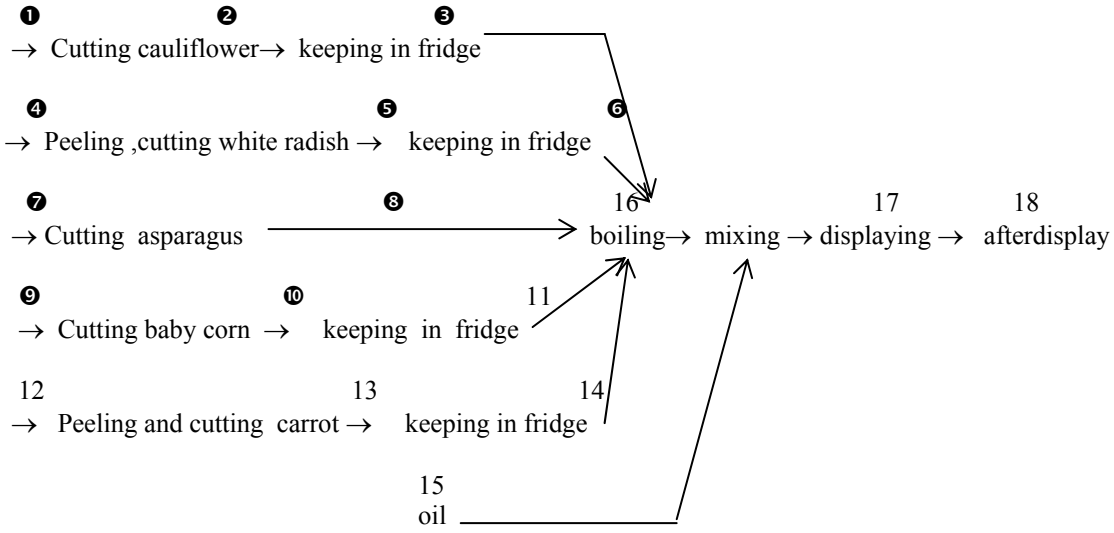
Pumpkin

❶ ❷ ❸ ❹
→ Peeling and cutting → keeping in fridge → boiling → displaying

❺
→ After displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	>1,100	<3	$4.8x10^4$	20	-	-	-	-
❷	23.0	<3	$1.0 x10^3$	10	-	-	-	-
❸	9.1	<3	$5.0 x10^3$	<10	-	-	-	-
❹	<3	<3	<10	<10	-	-	-	-
❺	9.1	<3	20	<10	-	-	-	-

Mixed vegetable



	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	>1,100	<3	$4.5x10^5$	$3.0x10^3$	-	-	-	-
❷	>1,100	3	$2.0 x10^5$	$2.0x10^3$	-	-	-	-
❸	1,100.0	<3	$1.6 x10^3$	$1.0x10^3$	-	-	-	-
❹	>1,100	3.0	$5.2x10^4$	$2.0x10^3$	-	-	-	-
❺	460.0	<3	20	<10	-	-	-	-
❻	290.0	<3	10	<10	-	-	-	-
❼	240	<3	$3.0 x10^4$	<10	-	-	-	-
❽	210	<3	$4.2x10^4$	<10	-	-	-	-
❾	460.0	<3	$3.0 x10^5$	<10	-	-	-	-
❿	210.0	<3	$3.7 x10^5$	<10	-	-	-	-
11	290	<3	$2.0x10^4$	<10	-	-	-	-
12	23	<3	$5.7 x10^4$	100	-	-	-	-
13	3.6	<3	$4.1 x10^4$	<10	-	-	-	-
14	3.6	<3	$6.0x10^3$	<10	-	-	-	-
15	<3	<3	<10	<10	-	-	-	-
16	<3	<3	<10	<10	-	-	-	-
17	<3	<3	<10	<10	-	-	-	-
18	460	<3	150	<10	-	-	-	-

Food contact surface

supermarket

Food contact surface	Total plate count(CFU / piece)	Yeast (CFU/piece)	Mold (CFU/piece)	*E.Coli*	S.a	Sal	V.c	C.p
Knife	210	<10	<10	-	-	-	-	-
Chopping block	$5.0x10^4$	<10	<10	-	-	-	-	-
Tray	20	<10	<10	-	-	-	-	-
A two edged knife	250	<10	<10	-	-	-	-	-
hands	650	<10	<10	-	-	-	-	-
Plastic bowl	10	<10	<10	-	-	-	-	-
Tongs	20	<10	<10	-	-	-	-	-
ladle	20	<10	<10	-	-	-	-	-
Water	<10	<10	<10	-	-	-	-	-

STREET VENDOR SALADS

Food contact surface	Total plate count(CFU / piece)	Yeast (CFU/piece)	Mold (CFU/piece)	*E.Coli*	S.a	Sal	V.c	C.p
Knife	50	<10	<10	-	-	-	-	-
Chopping block	$4.2x10^4$	<10	<10	-	-	-	-	-
Tray	150	<10	<10	-	-	-	-	-
A two edged knife	<10	<10	<10	-	-	-	-	-
hands	200	<10	<10	-	-	-	-	-
Plastic bowl	20	<10	<10	-	-	-	-	-
Tongs	40	<10	<10	-	-	-	-	-
ladle	20	<10	<10	-	-	-	-	-
เขือก	450	<10	<10	-	-	-	-	-
Water	<10	<10	<10	-	-	-	-	-

Mayonnaise

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
1	<3	<3	<10	<10	-	-	-	-
2	<3	<3	<10	<10	-	-	-	-
3	<3	<3	<10	<10	-	-	-	-
4	<3	<3	<10	<10	-	-	-	-
5	<3	<3	<10	<10	-	-	-	-
6	<3	<3	<10	<10	-	-	-	-
7	<3	<3	<10	<10	-	-	-	-
8	<3	<3	<10	<10	-	-	-	-
9	<3	<3	<10	<10	-	-	-	-
10	<3	<3	<10	<10	-	-	-	-
11	<3	<3	<10	<10	-	-	-	-
12	<3	<3	<10	<10	-	-	-	-

1. น้ำสลัด pure food สูตรไขมันต่ำโคเรสเตอรอลต่ำ
2. น้ำสลัด pure food สูตรไม่มีโคเรสเตอรอล
3. น้ำสลัด pure food สูตรไขมันต่ำโคเรสเตอรอลต่ำ รสไก่
4. น้ำสลัด pure food สูตรไม่มีโคเรสเตอรอล รสน้ำผึ้งผสมมะนาว
5. ครูสรรเสริญ สลัดครีม ไม่มีโคเรสเตอรอล
6. ครูสรรเสริญ สลัดครีมไม่มีโคเรสเตอรอล ไขมันต่ำ
7. ครูสรรเสริญ สลัดครีมพริกไทยดำ
8. ครูสรรเสริญ สลัดครีมรสฝรั่งเศส
9. สลัดครีมเลมอน ครูสรรเสริญ bestfood
10. สลัดครีมวาซาบิ ครูสรรเสริญ bestfood
11. สลัดครีมไทย spicy ครูสรรเสริญ bestfood
12. สลัดครีมมะเขือเทศ สูตรไลท์ ครูสรรเสริญ bestfood

2nd LABORATORY RESULT

Salad sold by street vendor

Cucumber

❶ ❷ ❸ ❹ ❺ ❻
→ Peeling→ cleaning → slicing → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	1,100.0	3.6	2.0×10^3	<10	-	-	-	-
❷	20.0	<3	150	<10	-	-	-	-
❸	<3	<3	20	<10	-	-	-	-
❹	<3	<3	20	<10	-	-	-	-
❺	3.0	<3	150	<10	-	-	-	-
❻	210.0	<3	250	<10	-	-	-	-

Lettuce

❶ ❷ ❸ ❹ ❺ ❻
→ Plucking leave → cleaning → cutting → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	>1,100	1,100.0	4.2×10^5	10	-	-	Non01	-
❷	>1,100	150.0	6.0×10^3	<10	-	-	-	-
❸	210.0	21.0	300	<10	-	-	-	-
❹	1,100	7.4	320	<10	-	-	-	-
❺	>1,100	16.0	7.0×10^3	<10	-	-	-	-
❻	>1,100	290.0	1.0×10^5	<10	-	-	-	-

Tomato

❶ ❷ ❸ ❹
→ Cleaning → slicing → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	36.0	<3	10	10	-	-	-	-
❷	15.0	<3	20	<10	-	-	-	-
❸	150.0	3.0	<10	<10	-	-	-	-
❹	>1,100	7.2	2.4×10^4	<10	-	-	-	-

Onion

❶ ❷ ❸ ❹ ❺
→ Peeling → cleaning → slicing → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	3.6	<3	20	10	-	-	-	-
❷	<3	<3	50	<10	-	-	-	-
❸	64.0	<3	10	<10	-	-	-	-
❹	150.0	<3	<10	<10	-	-	-	-
❺	150.0	3	10	<10	-	-	-	-

Carrot

❶ ❷ ❸ ❹ ❺
→ Peeling → cleaning → shredding → cleaning → displaying →

❻
after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	150	10	-	-	-	-
❷	<3	<3	10	20	-	-	-	-
❸	<3	<3	10	10	-	-	-	-
❹	7.4	3.0	30	<10	-	-	-	-
❺	43.0	38.0	10	<10	-	-	-	-
❻	28.0	21.0	10	10	-	-	-	-

Red kidney bean

❶ ❷ ❸ ❹ ❺
→ Putting in water→ boiling→ displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	3.0	<3	80	10	-	-	-	-
❷	93.0	3.0	50	<10	-	-	-	-
❸	15.0	3.0	20	<10	-	-	-	-
❹	240.0	<3	30	10	-	-	-	-
❺	1,100.0	<3	40	20	-	-	-	-

Boiled egg

❶ ❷ ❸
→ Boiling→ peeling → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	<10	<10	-	-	-	-
❷	<3	<3	<10	<10	-	-	-	-
❸	290	11	<10	10	-	-	-	-

Cabbage

❶ ❷ ❸ ❹ ❺
→ Peeling → shredding → putting in hard water → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	210.0	21.0	20	<10	-	-	-	-
❷	36.0	<3	<10	<10	-	-	-	-
❸	210.0	<3	<10	<10	-	-	-	-
❹	>1,100	15.0	<10	<10	-	-	-	-
❺	>1,100	35.0	<10	<10	-	-	-	-

Pineapple

❶ ❷ ❸ ❹ ❺ ❻
→ Peeling → cleaning → cutting → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	210.0	<3	$4.0x10^3$	30	-	-	-	-
❷	<3	<3	<10	<10	-	-	-	-
❸	<3	<3	20	<10	-	-	-	-
❹	<3	3.0	20	<10	-	-	-	-
❺	38.0	<3	40	<10	-	-	-	-
❻	160.0	43.0	$2.0x10^3$	<10	-	-	-	-

Barley

❶ ❷ ❸ ❹ ❺
→ Putting in water → boiling → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	7.4	<3	<10	<10	-	-	-	-
❷	<3	<3	<10	<10	-	-	-	-
❸	<3	<3	<10	<10	-	-	-	-
❹	<3	<3	<10	<10	+	-	-	-
❺	460.0	20.0	<10	<10	+	-	-	-

Boiled sweet potato

❶ ❷ ❸ ❹ ❺
→ Peeling → cutting → cleaning → boiling → displaying

❻
→ after displaying 2 hrs

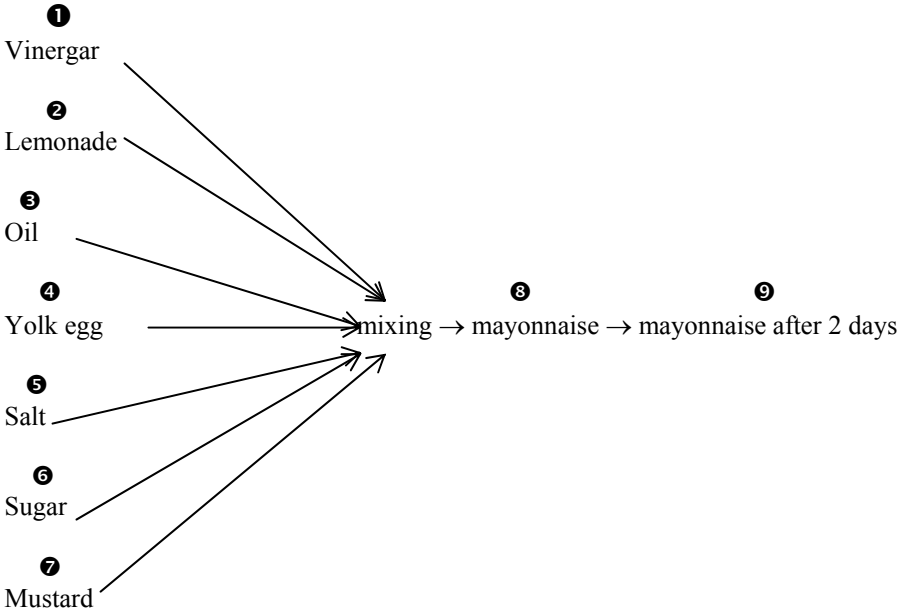
	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	1,100.0	3.0	$5.0x10^4$	50	-	-	-	-
❷	13.0	6.0	250	10	-	-	-	-
❸	9.0	<3	300	<10	-	-	-	-
❹	<3	<3	<10	<10	-	-	-	-
❺	290.0	15.0	30	<10	-	-	-	-
❻	>1,100	210.0	100	10	-	-	-	-

Corn

❶ ❷ ❸ ❹
→ Boiling → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	>1,100	210.0	$4.0x10^5$	10	-	-	-	-
❷	<3	<3	10	<10	-	-	-	-
❸	75.0	<3	20	<10	-	-	-	-
❹	>1,100	1,100	500	10	-	-	-	-

Mayonnaise dressing



	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	<10	<10	-	-	-	-
❷	<3	<3	<10	<10	-	-	-	-
❸	<3	<3	<10	<10	-	-	-	-
❹	<3	<3	<10	<10	-	-	-	-
❺	<3	<3	<10	<10	-	-	-	-
❻	<3	<3	<10	<10	-	-	-	-
❼	<3	<3	<10	<10	-	-	-	-
❽	<3	<3	<10	<10	-	-	-	-
❾	<3	<3	<10	<10	-	-	-	-

Salad bar in supermarket

Cucumber

❶ ❷ ❸ ❹ ❺
→ Peeling → cleaning → slicing → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	3.6	<3	200	<10	-	-	-	-
❷	<3	<3	50	<10	-	-	-	-
❸	<3	<3	50	<10	-	-	-	-
❹	15.0	<3	500	<10	-	-	-	-
❺	20.0	<3	600	<10	-	-	-	-

Water nut

❶ ❷
Decaning → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	<10	<10	-	-	-	-
❷	<3	<3	<10	<10	-	-	-	-

Corn

❶ ❷
Decaning → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	<10	<10	-	-	-	-
❷	<3	<3	<10	<10	-	-	-	-

Garden pea

❶ ❷
Decaning → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	<10	<10	-	-	-	-
❷	<3	<3	<10	<10	-	-	-	-

Tomato

❶ ❷ ❸ ❹
→ Cleaning → slicing → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	7.4	<3	20	<10	-	-	-	-
❷	<3	<3	10	<10	-	-	-	-
❸	43.0	<3	<10	<10	-	-	-	-
❹	1,100.0	<3	<10	<10	-	-	-	-

Onion

❶ ❷ ❸ ❹ ❺
→ Peeling → cleaning → slicing → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	7.4	<3	$2.3x10^3$	10	-	-	-	-
❷	<3	<3	900	<10	-	-	-	-
❸	<3	<3	200	<10	-	-	-	-
❹	20.0	<3	$2.0 x10^3$	<10	-	-	-	-
❺	21.0	<3	$5.0 x10^3$	10	-	-	-	-

Jelly

❶ ❷
Decaning → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	<10	<10	-	-	-	-
❷	<3	<3	<10	<10	-	-	-	-

Baby corn

❶ ❷ ❸ ❹
→ Cutting → boiling → putting in water → dewatering → displaying

❺
→ After displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	210.0	7.2	$2.0x10^3$	20	-	-	-	-
❷	1,100.0	3.6	$3.0x10^3$	<10	-	-	-	-
❸	<3	<3	<10	<10	-	-	-	-
❹	<3	<3	<10	<10	-	-	-	-
❺	<3	<3	10	<10	-	-	-	-

Lettuce

❶ ❷ ❸ ❹
→ Cutting → cleaning → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	>1,100	210.0	$1.0x10^5$	<10	-	-	-	-
❷	21.0	7.4	$1.2x10^5$	<10	-	-	-	-
❸	3.0	<3	200	10	-	-	-	-
❹	11.0	<3	300	<10	-	-	-	-

Red kidney bean

❶ ❷
Decaning → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	<10	<10	-	-	-	-
❷	<3	<3	<10	<10	-	-	-	-

Asparagus

❶ ❷ ❸ ❹
→ Cutting → boiling → putting in water → dewatering → displaying

❺
→ After displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	93.0	21.0	$2.0x10^4$	30	-	-	-	-
❷	210.0	3.0	$2.5x10^4$	<10	-	-	-	-
❸	<3	<3	<10	<10	-	-	-	-
❹	<3	<3	200	<10	-	-	-	-
❺	7.2	<3	300	20	-	-	-	-

Pineapple

❶ ❷ ❸
→ Peeling → cutting → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	75.0	<3	50	10	-	-	-	-
❷	7.2	<3	20	<10	-	-	-	-
❸	<3	<3	30	10	-	-	-	-

Cantaloupe

❶ ❷ ❸
→ Peeling → cutting → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	210.0	14.0	10	<10	-	-	-	-
❷	21.0	<3	<10	<10	-	-	-	-
❸	240.0	<3	20	<10	-	-	-	-

Apple salad

❶ ❷ ❸ ❹
→ Cutting → cleaning → mayonnaise → mixing → displaying

❺
→ after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	3.0	<3	20	10	-	-	-	-
❷	<3	<3	<10	<10	-	-	-	-
❸	<3	<3	50	<10	-	-	-	-
❹	<3	<3	100	<10	-	-	-	-
❺	6.1	3.0	120	10	-	-	-	-

Red cabbage

❶ ❷ ❸ ❹ ❺
→ shredding→ keeping in fridge→ cleaning → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	29.0	3.0	$3.0x10^4$	30	-	-	-	-
❷	28.0	<3	$1.0x10^4$	20	-	-	-	-
❸	21.0	<3	130	20	-	-	-	-
❹	36.0	<3	60	<10	-	-	-	-
❺	290.0	<3	100	10	-	-	-	-

Cabbage

❶ ❷ ❸ ❹ ❺
→ shredding→ keeping in fridge → cleaning → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	23.0	<3	$1.0x10^5$	80	-	-	-	-
❷	15.0	<3	$8.0x10^4$	100	-	-	-	-
❸	9.2	<3	300	50	-	-	-	-
❹	<3	<3	300	<10	-	-	-	-
❺	28.0	<3	350	10	-	-	-	-

Potato

❶ ❷ ❸
→ Peeling → cutting → putting in water→ keeping in fridge → cleaning

❹ ❺ ❻
→ boiling → Displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	3.6	<3	$1.0x10^4$	10	-	-	-	-
❷	11.0	3.0	$2.0 x10^4$	10	-	-	-	-
❸	9.2	<3	$2. x10^3$	<10	-	-	-	-
❹	3.0	<3	600	<10	-	-	-	-
❺	<3	<3	<10	<10	-	-	-	-
❻	15.0	<3	40	20	-	-	-	-

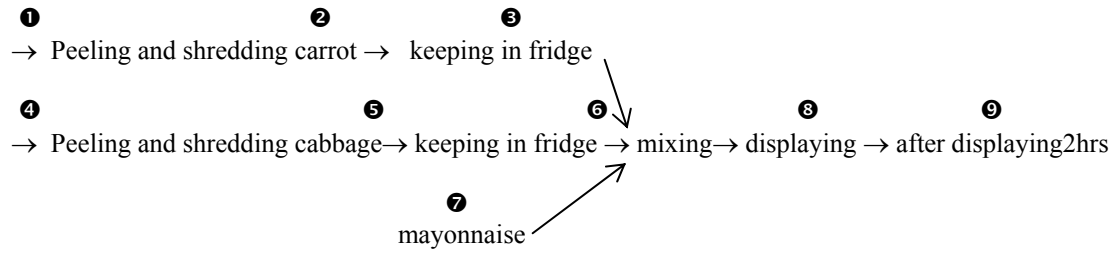
Taro

❶ ❷ ❸ ❹
→ Peeling→ cutting → putting in water→ boiling → displaying

❺
→ After displaying 2 hrs

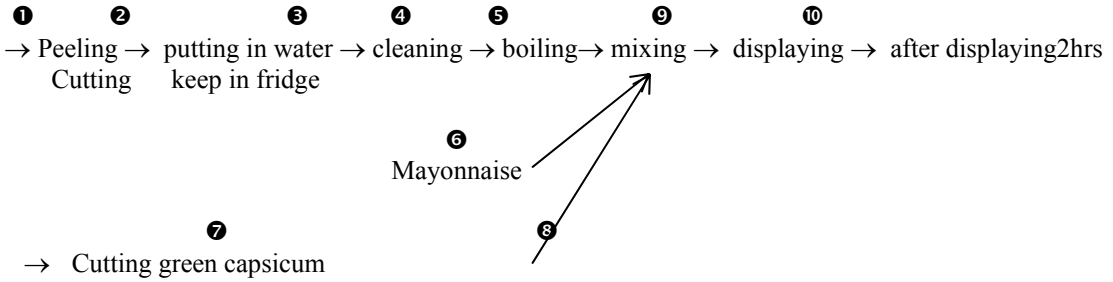
	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	290.0	43.0	$2.0x10^4$	<10	-	-	-	-
❷	15.0	<3	$1.3 x10^4$	<10	-	-	-	-
❸	1,100.0	<3	$1.2 x10^3$	<10	-	-	-	-
❹	<3	<3	<10	<10	-	-	-	-
❺	6.1	<3	20	<10	-	-	-	-

Coleslow



	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	43.0	<3	$5.0x10^4$	10	-	-	-	-
❷	7.4	<3	20	<10	-	-	-	-
❸	3.0	<3	10	<10	-	-	-	-
❹	<3	<3	$1.2x10^5$	<10	-	-	-	-
❺	7.2	<3	$1.0 x10^5$	<10	-	-	-	-
❻	150.0	<3	$1.0 x10^4$	<10	-	-	-	-
❼	<3	<3	80	<10	-	-	-	-
❽	150.0	<3	$2.0x10^3$	10	-	-	-	-
❾	290.0	<3	$2.5 x10^3$	20	-	-	-	-

Potato salad



	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	3.0	<3	$1.5x10^3$	200	-	-	-	-
❷	15.0	<3	650	20	-	-	-	-
❸	28.0	15	120	<10	-	-	-	-
❹	7.4	3	100	<10	-	-	-	-
❺	<3	<3	<10	<10	-	-	-	-
❻	<3	<3	90	<10	-	-	-	-
❼	<3	<3	<10	<10	-	-	-	-
❽	<3	<3	<10	<10	-	-	-	-
❾	24.0	<3	$3x10^3$	10	-	-	-	-
❿	210.0	<3	$4x10^4$	20	-	-	-	-

Carrot

❶ ❷ ❸ ❹
→ Peeling and shredding → keeping in fridge → cleaning → displaying

❺
→ after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	15.0	<3	$4.5x10^3$	50	-	-	-	-
❷	7.4	<3	$1.5 x10^5$	20	-	-	-	-
❸	3.0	<3	$5.0 x10^3$	<10	-	-	-	-
❹	20.0	<3	800	<10	-	-	-	-
❺	120.0	<3	$1.0 x10^3$	100	-	-	-	-

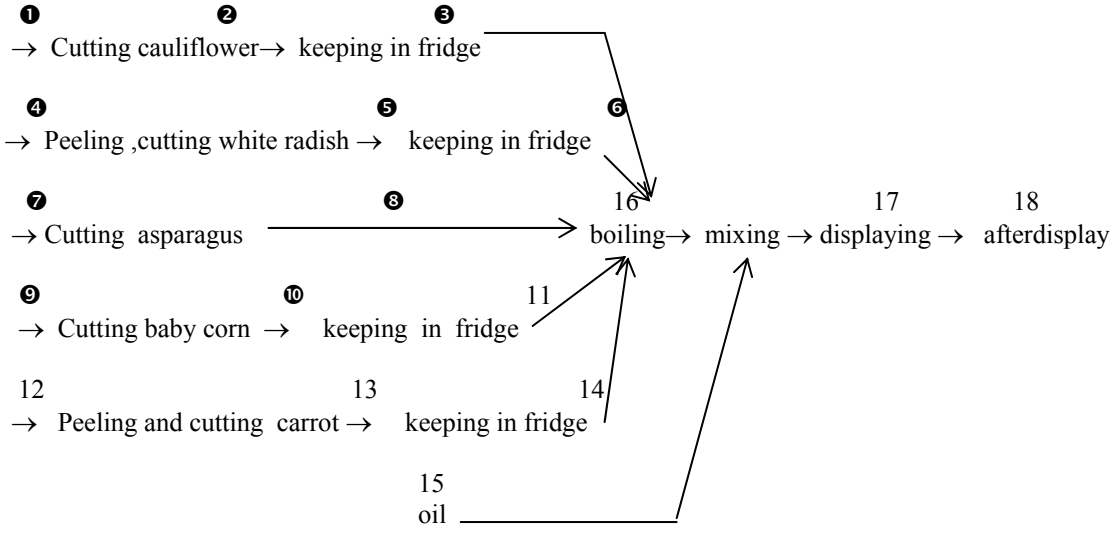
Pumpkin

❶ ❷ ❸ ❹
→ Peeling and cutting → keeping in fridge → boiling → displaying

❺
→ After displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	210.0	<3	$3.0x10^4$	20	-	-	-	-
❷	15.0	<3	750	<10	-	-	-	-
❸	7.4	<3	$1x10^3$	<10	-	-	-	-
❹	<3	<3	<10	<10	-	-	-	-
❺	<3	<3	<10	<10	-	-	-	-

Mixed vegetable



	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	1,100.0	<3	$3.2x10^5$	$2.5x10^3$	-	-	-	-
❷	1,100.0	3	$1.5 x10^5$	$1.8x10^3$	-	-	-	-
❸	210.0	3	$1.0 x10^3$	150	-	-	-	-
❹	>1,100	6.1	$4.0x10^4$	20	-	-	-	-
❺	290.0	<3	20	<10	-	-	-	-
❻	36.0	<3	20	<10	-	-	-	-
❼	150.0	<3	$2.8 x10^4$	<10	-	-	-	-
❽	210.0	<3	$3.6x10^4$	<10	-	-	-	-
❾	290.0	<3	$2.0 x10^5$	<10	-	-	-	-
❿	210.0	<3	$3.0 x10^5$	<10	-	-	-	-
11	290.0	<3	$1.2x10^4$	<10	-	-	-	-
12	38.0	<3	$5.0 x10^4$	80	-	-	-	-
13	7.4	<3	$3.6 x10^4$	<10	-	-	-	-
14	3.0	<3	$4.5x10^3$	<10	-	-	-	-
15	<3	<3	<10	<10	-	-	-	-
16	<3	<3	<10	<10	-	-	-	-
17	<3	<3	<10	<10	-	-	-	-
18	210.0	<3	10	<10	-	-	-	-

Food contact surface

Salad bar in supermarket

Food contact surface	Total plate count(CFU / piece)	Yeast (CFU/piece)	Mold (CFU/piece)	*E.Coli*	S.a	Sal	V.c	C.p
Knife	15	<10	<10	-	-	-	-	-
Chopping block	$4.6x10^4$	<10	<10	-	-	-	-	-
Tray	30	<10	<10	-	-	-	-	-
A two edged knife	<10	<10	<10	-	-	-	-	-
hands	150	<10	<10	-	-	-	-	-
Plastic bowl	40	<10	<10	-	-	-	-	-
Tongs	30	<10	<10	-	-	-	-	-
laddle	20	<10	<10	-	-	-	-	-
Water	<10	<10	<10	-	-	-	-	-

Salad sold by street vendor

Food contact surface	Total plate count(CFU / piece)	Yeast (CFU/piece)	Mold (CFU/piece)	*E.Coli*	S.a	Sal	V.c	C.p
Knife	<10	<10	<10	-	-	-	-	-
Chopping block	$7.0x10^3$	<10	<10	-	-	-	-	-
Tray	150	<10	<10	-	-	-	-	-
A two edged knife	<10	<10	<10	-	-	-	-	-
hands	700	<10	<10	-	-	-	-	-
Plastic bowl	50	<10	<10	-	-	-	-	-
Tongs	<10	<10	<10	-	-	-	-	-
ladle	40	<10	<10	-	-	-	-	-
เขียง	150	<10	<10	-	-	-	-	-
Water	<10	<10	<10	-	-	-	-	-

Mayonnaise

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
1	<3	<3	<10	<10	-	-	-	-
2	<3	<3	<10	<10	-	-	-	-
3	<3	<3	<10	<10	-	-	-	-
4	<3	<3	<10	<10	-	-	-	-
5	<3	<3	<10	<10	-	-	-	-
6	<3	<3	<10	<10	-	-	-	-
7	<3	<3	<10	<10	-	-	-	-
8	<3	<3	<10	<10	-	-	-	-
9	<3	<3	<10	<10	-	-	-	-
10	<3	<3	<10	<10	-	-	-	-
11	<3	<3	<10	<10	-	-	-	-
12	<3	<3	<10	<10	-	-	-	-

1.น้ำสลัด pure food สูตรไขมันต่ำโคเรสเตอรอลต่ำ

2.น้ำสลัด pure food สูตรไม่มีโคเรสเตอรอล

3.น้ำสลัด pure food สูตรไขมันต่ำโคเรสเตอรอลต่ำ รสไก่

4.น้ำสลัด pure food สูตรไม่มีโคเรสเตอรอล รสน้ำผึ้งผสมมะนาว

5.ครูสรรเสริญ สลัดครีม ไม่มีโคเรสเตอรอล

6.ครูสรรเสริญ สลัดครีมไม่มีโคเรสเตอรอล ไขมันต่ำ

7.ครูสรรเสริญ สลัดครีมพริกไทยดำ

8.ครูสรรเสริญ สลัดครีมรสฝรั่งเศส

9.สลัดครีมเลมอน ครูสรรเสริญ bestfood

10.สลัดครีมวาซาบิ ครูสรรเสริญ bestfood

11.สลัดครีมไทย spicy ครูสรรเสริญ bestfood

12.สลัดครีมมะเขือเทศ สูตรไลท์ ครูสรรเสริญ bestfood

3rd LABORATORY RESULT

Salad sold by street vendor

Cucumber

❶ ❷ ❸ ❹ ❺ ❻
→ Peeling→ cleaning → slicing → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	290.0	<3	5.0×10^4	10	-	-	-	-
❷	14.0	<3	20	<10	-	-	-	-
❸	<3	<3	<10	<10	-	-	-	-
❹	<3	<3	20	<10	-	-	-	-
❺	12.0	<3	40	10	-	-	-	-
❻	290.0	<3	150	<10	-	-	-	-

Lettuce

❶ ❷ ❸ ❹ ❺ ❻
→ Plucking leave → cleaning → cutting → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	1,100.0	290.0	3.0×10^5	10	-	-	Non01	-
❷	460.0	53.0	4.0×10^3	<10	-	-	-	-
❸	290.0	15.0	330	<10	-	-	-	-
❹	210.0	7.2.0	270	<10	-	-	-	-
❺	>1,100	24.0	300	<10	-	-	-	-
❻	>1,100	53.0	450	<10	-	-	-	-

Tomato

❶ ❷ ❸ ❹
→ Cleaning → slicing → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	42.0	<3	10	10	-	-	-	-
❷	39.0	<3	<10	<10	-	-	-	-
❸	150.0	<3	<10	<10	-	-	-	-
❹	53.0	3.6	6.0×10^3	<10	-	-	-	-

Onion

❶ ❷ ❸ ❹ ❺
→ Peeling → cleaning → slicing → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	3.0	<3	20	<10	-	-	-	-
❷	3.0	<3	10	<10	-	-	-	-
❸	23.0	<3	40	<10	-	-	-	-
❹	23.0	<3	10	10	-	-	-	-
❺	210.0	<3	10	10	-	-	-	-

Carrot

❶ ❷ ❸ ❹ ❺
→ Peeling → cleaning → shredding → cleaning → displaying →

❻
after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	1.0×10^3	30	-	-	-	-
❷	<3	<3	20	10	-	-	-	-
❸	<3	<3	20	<10	-	-	-	-
❹	3.0	<3	10	<10	-	-	-	-
❺	20.0	20.0	150	<10	-	-	-	-
❻	29.0	15.0	130	10	-	-	-	-

Red kidney bean

❶ ❷ ❸ ❹ ❺
→ Putting in water→ boiling→ displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	100	20	-	-	-	-
❷	21.0	<3	80	10	-	-	-	-
❸	6.2	3.0	10	<10	-	-	-	-
❹	150.0	<3	20	<10	-	-	-	-
❺	>1,100	<3	30	10	-	-	-	-

Boiled egg

❶ ❷ ❸
→ Boiling→ peeling → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	<10	<10	-	-	-	-
❷	<3	<3	<10	<10	-	-	-	-
❸	290	7.3	<10	<10	-	-	-	-

Cabbage

❶ ❷ ❸ ❹ ❺
→ Peeling → shredding → putting in hard water → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	290.0	20.0	<10	<10	-	-	-	-
❷	290.0	<3	10	<10	-	-	-	-
❸	490.0	<3	<10	<10	-	-	-	-
❹	1,100.0	15.0	<10	<10	-	-	-	-
❺	>1,100	93.0	<10	10	-	-	-	-

Pineapple

❶ ❷ ❸ ❹ ❺ ❻
→ Peeling → cleaning → cutting → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	93.0	<3	<10	<10	-	-	-	-
❷	<3	<3	<10	<10	-	-	-	-
❸	<3	<3	<10	<10	-	-	-	-
❹	<3	<3	<10	<10	-	-	-	-
❺	15.0	<3	10	<10	-	-	-	-
❻	35.0	<3	$1.0x10^3$	<10	-	-	-	-

Baley

❶ ❷ ❸ ❹ ❺
→ Putting in water → boiling → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	<10	<10	-	-	-	-
❷	<3	<3	10	<10	-	-	-	-
❸	<3	<3	<10	<10	-	-	-	-
❹	210.0	<3	<10	<10	-	-	-	-
❺	1,100.0	7.2	<10	<10	-	-	-	-

Boiled sweet potato

❶ ❷ ❸ ❹ ❺
→ Peeling → cutting → cleaning → boiling → displaying

❻
→ after displaying 2 hrs

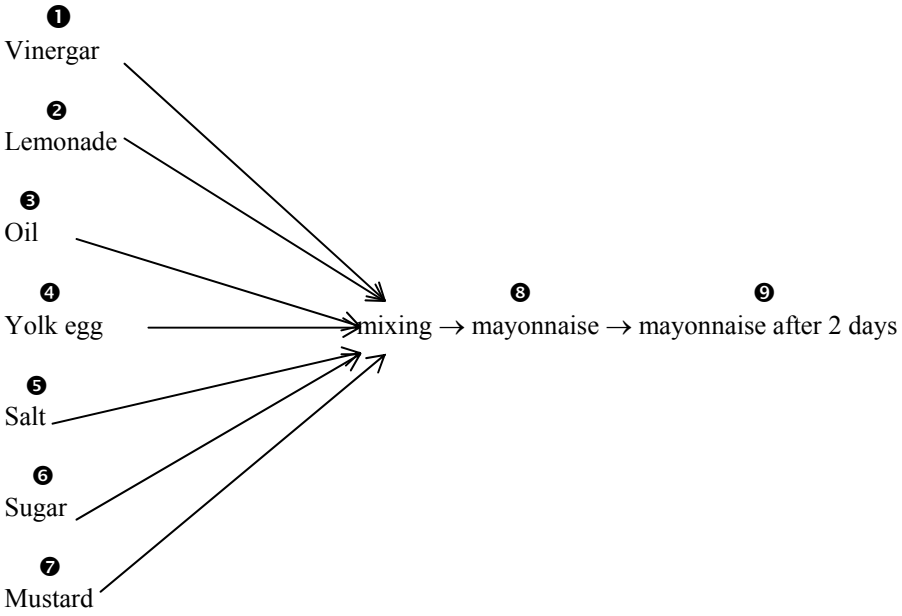
	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	210.0	<3	$3.0x10^4$	20	-	-	-	-
❷	16.0	<3	$8.2x10^2$	<10	-	-	-	-
❸	13.0	<3	100	<10	-	-	-	-
❹	<3	<3	<10	<10	-	-	-	-
❺	24.0	11.0	20	2	-	-	-	-
❻	>1,100	42.0	200	10	-	-	-	-

Corn

❶ ❷ ❸ ❹
→ Boiling → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	1,100.0	290.0	$3.0x10^4$	<10	-	-	-	-
❷	<3	<3	<10	<10	-	-	-	-
❸	16.0	<3	<10	<10	-	-	-	-
❹	>1,100	210.0	300	10	-	-	-	-

Mayonnaise dressing



	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	<10	<10	-	-	-	-
❷	<3	<3	<10	<10	-	-	-	-
❸	<3	<3	<10	<10	-	-	-	-
❹	<3	<3	<10	<10	-	-	-	-
❺	<3	<3	<10	<10	-	-	-	-
❻	<3	<3	<10	<10	-	-	-	-
❼	<3	<3	<10	<10	-	-	-	-
❽	<3	<3	<10	<10	-	-	-	-
❾	<3	<3	<10	<10	-	-	-	-

Salad bar in supermarket

Cucumber

❶ ❷ ❸ ❹ ❺
→ Peeling → cleaning → slicing → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	3.0	<3	120	<10	-	-	-	-
❷	<3	<3	30	<10	-	-	-	-
❸	<3	<3	30	<10	-	-	-	-
❹	<3	<3	30	<10	-	-	-	-
❺	14.0	<3	180	10	-	-	-	-

Water nut

❶ ❷
Decaning → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	<10	<10	-	-	-	-
❷	<3	<3	<10	<10	-	-	-	-

Corn

❶ ❷
Decaning → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	<10	<10	-	-	-	-
❷	<3	<3	<10	<10	-	-	-	-

Garden pea

❶ ❷
Decaning → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	<10	<10	-	-	-	-
❷	<3	<3	<10	<10	-	-	-	-

Tomato

❶ ❷ ❸ ❹
→ Cleaning → slicing → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	43.0	<3	10	<10	-	-	-	-
❷	15.0	<3	<10	<10	-	-	-	-
❸	14.0	<3	<10	<10	-	-	-	-
❹	290.0	<3	<10	<10	-	-	-	-

Onion

❶ ❷ ❸ ❹ ❺
→ Peeling → cleaning → slicing → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	$1.5x10^3$	20	-	-	-	-
❷	<3	<3	150	20	-	-	-	-
❸	<3	<3	300	<10	-	-	-	-
❹	21.0	<3	$1.7 x10^3$	<10	-	-	-	-
❺	11.0	<3	$3.0 x10^3$	10	-	-	-	-

Jelly

❶ ❷
Decaning → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	<10	<10	-	-	-	-
❷	<3	<3	<10	<10	-	-	-	-

Baby corn

❶ ❷ ❸ ❹
→ Cutting → boiling → putting in water → dewatering → displaying

❺
→ After displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	1,100	3.6	$2.7x10^3$	10	-	-	-	-
❷	1,100	7.3	$3.5x10^3$	<10	-	-	-	-
❸	<3	<3	15	<10	-	-	-	-
❹	<3	<3	10	<10	-	-	-	-
❺	<3	<3	10	<10	-	-	-	-

Lettuce

❶ ❷ ❸ ❹
→ Cutting → cleaning → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	1,100.0	150.0	$2.2x10^5$	<10	-	-	-	-
❷	1,100.0	29.0	$1.8x10^5$	<10	-	-	-	-
❸	3.6	<3	300	<10	-	-	-	-
❹	11.0	<3	400	10	-	-	-	-

Red kidney bean

❶ ❷
Decaning → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	<10	<10	-	-	-	-
❷	3.0	<3	<10	<10	-	-	-	-

Asparagus

❶ ❷ ❸ ❹
→ Cutting → boiling → putting in water → dewatering → displaying

❺
→ After displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	150.0	43.0	$2.4x10^4$	20	-	-	-	-
❷	53.0	<3	$3.0x10^4$	<10	-	-	-	-
❸	<3	<3	10	<10	-	-	-	-
❹	<3	<3	130	10	-	-	-	-
❺	6.1	<3	250	10	-	-	-	-

Pineapple

❶ ❷ ❸
→ Peeling → cutting → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	29.0	<3	20	20	-	-	-	-
❷	<3	<3	10	<10	-	-	-	-
❸	<3	<3	20	10	-	-	-	-

Cantaloupe

❶ ❷ ❸
→ Peeling → cutting → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	1,100.0	28.0	20	<10	-	-	-	-
❷	26.0	<3	<10	<10	-	-	-	-
❸	460.0	<3	<10	<10	-	-	-	-

Apple salad

❶ ❷ ❸ ❹
→ Cutting → cleaning → mayonnaise → mixing → displaying

❺
→ after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	10	<10	-	-	-	-
❷	<3	<3	<10	<10	-	-	-	-
❸	<3	<3	100	<10	-	-	-	-
❹	<3	<3	130	<10	-	-	-	-
❺	<3	<3	120	10	-	-	-	-

Red cabbage

❶ ❷ ❸ ❹ ❺
→ shredding→ keeping in fridge→ cleaning → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	21.0	<3	$4.0x10^4$	20	-	-	-	-
❷	15.0	<3	$2.0x10^4$	10	-	-	-	-
❸	150.0	<3	100	<10	-	-	-	-
❹	210.0	<3	40	<10	-	-	-	-
❺	210.0	<3	120	20	-	-	-	-

Cabbage

❶ ❷ ❸ ❹ ❺
→ shredding→ keeping in fridge → cleaning → displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	3.0	<3	$1.2x10^5$	20	-	-	-	-
❷	3.0	<3	$1.0x10^5$	10	-	-	-	-
❸	150.0	<3	300	<10	-	-	-	-
❹	29.0	<3	200	10	-	-	-	-
❺	15.0	<3	230	10	-	-	-	-

Potato

❶ ❷ ❸
→ Peeling → cutting → putting in water→ keeping in fridge → cleaning

❹ ❺ ❻
→ boiling → Displaying → after displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	$9.0x10^3$	30	-	-	-	-
❷	39.0	3.0	$7.0 x10^3$	20	-	-	-	-
❸	21.0	21.0	900	<10	-	-	-	-
❹	7.3	3.6	200	<10	-	-	-	-
❺	<3	<3	10	<10	-	-	-	-
❻	3.0	<3	150	20	-	-	-	-

Taro

❶ ❷ ❸ ❹
→ Peeling→ cutting → putting in water→ boiling → displaying

❺
→ After displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	210.0	9.1	$3.2x10^4$	10	-	-	-	-
❷	7.3	<3	$2.0 x10^4$	<10	-	-	-	-
❸	290.0	<3	$1.5 x10^3$	<10	-	-	-	-
❹	<3	<3	<10	<10	-	-	-	-
❺	7.3	<3	<10	<10	-	-	-	-

Coleslow

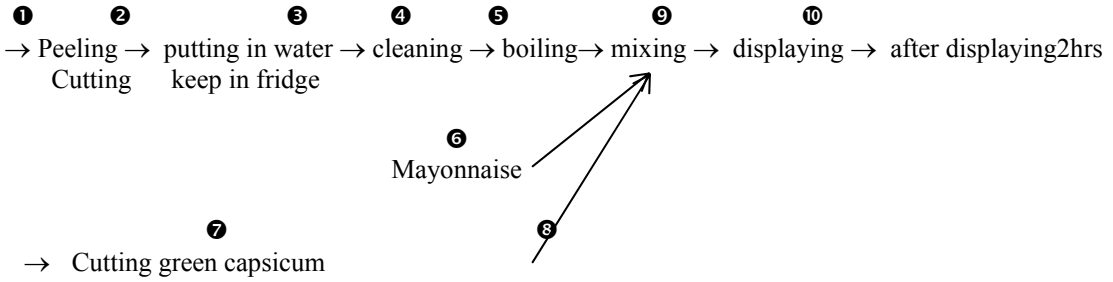
❶ ❷ ❸
→ Peeling and shredding carrot → keeping in fridge

❹ ❺ ❻ ❽ ❾
→ Peeling and shredding cabbage→ keeping in fridge → mixing→ displaying → after displaying2hrs

❼
mayonnaise

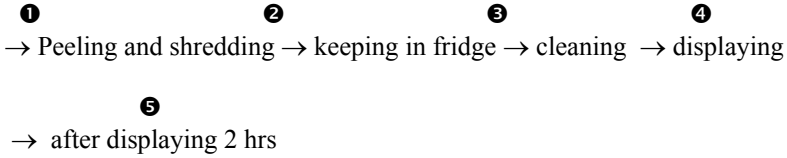
	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	15.0	<3	$4.2x10^4$	10	-	-	-	-
❷	3.6	<3	20	<10	-	-	-	-
❸	3.0	<3	10	<10	-	-	-	-
❹	<3	<3	$1.3x10^5$	<10	-	-	-	-
❺	3.6	<3	$1.1 x10^5$	<10	-	-	-	-
❻	35.0	<3	$2.0 x10^4$	<10	-	-	-	-
❼	<3	<3	120	<10	-	-	-	-
❽	150.0	<3	$2.3x10^3$	10	-	-	-	-
❾	290.0	<3	$2.8 x10^3$	20	-	-	-	-

Potato salad



	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	<3	<3	$1.0x10^3$	100	-	-	-	-
❷	39.0	<3	350	50	-	-	-	-
❸	150.0	15.0	120	<10	-	-	-	-
❹	7.3	3.0	80	<10	-	-	-	-
❺	<3	<3	0	<10	-	-	-	-
❻	<3	<3	50	<10	-	-	-	-
❼	<3	<3	<10	<10	-	-	-	-
❽	<3	<3	<10	<10	-	-	-	-
❾	120	<3	550	<10	-	-	-	-
❿	95.0	<3	$1x10^3$	10	-	-	-	-

Carrot



	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	15.0	<3	$4.0x10^3$	20	-	-	-	-
❷	3.6	<3	$1.0 x10^5$	10	-	-	-	-
❸	3.0	<3	$3.0 x10^3$	<10	-	-	-	-
❹	11.0	<3	400	100	-	-	-	-
❺	28.0	<3	900	100	-	-	-	-

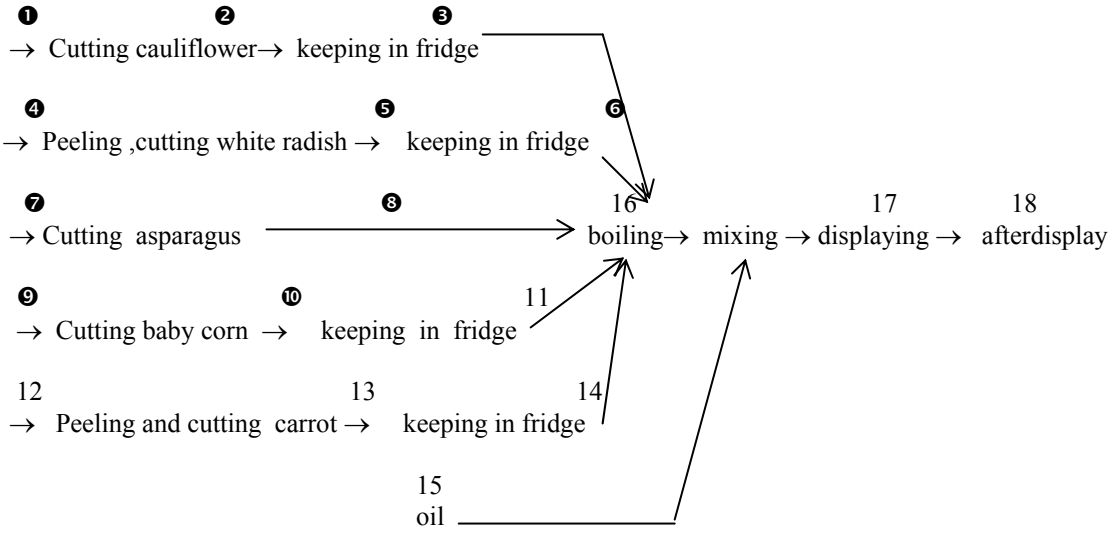
Pumpkin

❶ ❷ ❸ ❹
→ Peeling and cutting → keeping in fridge → boiling → displaying

❺
→ After displaying 2 hrs

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	1,100.0	<3	$3.5x10^4$	20	-	-	-	-
❷	15.0	<3	550	<10	-	-	-	-
❸	9.1	<3	750	<10	-	-	-	-
❹	<3	<3	<10	<10	-	-	-	-
❺	9.1	<3	<10	<10	-	-	-	-

Mixed vegetable



	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
❶	210.0	<3	$4.0x10^5$	$2.0x10^3$	-	-	-	-
❷	290.0	<3	$1.7 x10^5$	750	-	-	-	-
❸	210.0	<3	$1.2 x10^3$	250	-	-	-	-
❹	1,100.0	3.0	$4.5x10^4$	$1.5x10^3$	-	-	-	-
❺	>1,100	<3	$3.2x10^3$	<10	-	-	-	-
❻	42.0	<3	$1.2x10^3$	10	-	-	-	-
❼	95.0	9.1	$3.2 x10^4$	<10	-	-	-	-
❽	1,100.0	<3	$4.0x10^4$	<10	-	-	-	-
❾	1,100.0	3.0	$2.7 x10^5$	<10	-	-	-	-
❿	1,100.0	11.0	$4.2 x10^5$	<10	-	-	-	-
11	210.0	7.2	$1.6x10^4$	<10	-	-	-	-
12	43	<3	$4.8 x10^4$	100	-	-	-	-
13	3.6	<3	$4.0 x10^4$	<10	-	-	-	-
14	7.3	<3	$5.0x10^3$	<10	-	-	-	-
15	<3	<3	<10	<10	-	-	-	-
16	<3	<3	<10	<10	-	-	-	-
17	20.0	3.0	150	<10	-	-	-	-
18	150.0	<3	270	<10	-	-	-	-

Food contact surface

Salad bar in supermarket

Food contact surface	Total plate count(CFU / piece)	Yeast (CFU/piece)	Mold (CFU/piece)	*E.Coli*	S.a	Sal	V.c	C.p
Knife	20	<10	<10	-	-	-	-	-
Chopping block	$4.2x10^4$	<10	<10	-	-	-	-	-
Tray	<10	<10	<10	-	-	-	-	-
A two edged knife	$2.0x10^2$	<10	<10	-	-	-	-	-
hands	40	<10	<10	-	-	-	-	-
Plastic bowl	20	<10	<10	-	-	-	-	-
Tongs	<10	<10	<10	-	-	-	-	-
laddle	<10	<10	<10	-	-	-	-	-
Water	<10	<10	<10	-	-	-	-	-

Salad sold by street vendor

Food contact surface	Total plate count(CFU / piece)	Yeast (CFU/piece)	Mold (CFU/piece)	*E.Coli*	S.a	Sal	V.c	C.p
Knife	<10	<10	<10	-	-	-	-	-
Chopping block	$2x10^4$	<10	<10	-	-	-	-	-
Tray	200	<10	<10	-	-	-	-	-
A two edged knife	<10	<10	<10	-	-	-	-	-
hands	$6.3x10^2$	<10	<10	-	-	-	-	-
Plastic bowl	<10	<10	<10	-	-	-	-	-
Tongs	20	<10	<10	-	-	-	-	-
ladle	20	<10	<10	-	-	-	-	-
เขือก	530	<10	<10	-	-	-	-	-
Water	<10	<10	<10	-	-	-	-	-

Mayonnaise

	MPN coliform / g	MPN *E.coli* /g	Yeast CFU/g	Mold CFU/g	S.a	Sal	V.c	C.p
1	<3	<3	<10	<10	-	-	-	-
2	<3	<3	<10	<10	-	-	-	-
3	<3	<3	<10	<10	-	-	-	-
4	<3	<3	<10	<10	-	-	-	-
5	<3	<3	<10	<10	-	-	-	-
6	<3	<3	<10	<10	-	-	-	-
7	<3	<3	<10	<10	-	-	-	-
8	<3	<3	<10	<10	-	-	-	-
9	<3	<3	<10	<10	-	-	-	-
10	<3	<3	<10	<10	-	-	-	-
11	<3	<3	<10	<10	-	-	-	-
12	<3	<3	<10	<10	-	-	-	-

1.น้ำสลัด pure food สูตรไขมันต่ำโคเรสเตอรอลต่ำ

2.น้ำสลัด pure food สูตรไม่มีโคเรสเตอรอล

3.น้ำสลัด pure food สูตรไขมันต่ำโคเรสเตอรอลต่ำ รสไก่

4.น้ำสลัด pure food สูตรไม่มีโคเรสเตอรอล รสน้ำผึ้งผสมมะนาว

5.ครูสรรเสริญ สลัดครีม ไม่มีโคเรสเตอรอล

6.ครูสรรเสริญ สลัดครีมไม่มีโคเรสเตอรอล ไขมันต่ำ

7.ครูสรรเสริญ สลัดครีมพริกไทยดำ

8.ครูสรรเสริญ สลัดครีมรสฝรั่งเศส

9.สลัดครีมเลมอน ครูสรรเสริญ bestfood

10.สลัดครีมวาซาบิ ครูสรรเสริญ bestfood

11.สลัดครีมไทย spicy ครูสรรเสริญ bestfood

12.สลัดครีมมะเขือเทศ สูตรไลท์ ครูสรรเสริญ bestfood

Appendix E

Pictures of the preparation steps and displaying of salad sold by street vendor

Preparation of boiled ingredients.

Salad ingredients during displays (1)

Salad ingredients during displays (2)

BIOGRAPHY

NAME	Miss Chutima Jongpakdee
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