

**ASSESSMENT OF HAZARD ANALYSIS CRITICAL CONTROL  
POINT (HACCP) OF FAST FOOD (*MOMO*) FROM RESTAURANTS  
OF KATHMANDU METROPOLITAN CITY WITH RESPECT TO  
ENVIRONMENTAL CONDITION**

**A**

**Dissertation**

**Submitted to the Central Department of Microbiology  
Tribhuvan University**

**In Partial Fulfilment of the Requirements for the Award of the Degree of  
Master of Science in Microbiology (Environment & Public-Health)**

**by**

**Poonam Thapa**

**Central Department of Microbiology  
Tribhuvan University  
Kirtipur, Kathmandu, Nepal  
2006**

## RECOMMENDATION

This is to certify that Ms. Poonam Thapa has completed this dissertation work entitled **“ASSESSMENT OF HAZARD ANALYSIS CRITICAL CONTROL POINT (HACCP) OF FAST FOOD (*MOMO*) FROM RESTAURANTS OF KATHMANDU METROPOLITAN CITY WITH RESPECT TO ENVIRONMENTAL CONDITION”** as a partial fulfillment of M.Sc. Degree in Microbiology under our supervision. To our knowledge this thesis work has not been submitted for any other degree.

**Dr. Anjana Singh, Ph. D**

Associate Professor

Central Department of  
Microbiology

Tribhuvan University

Kirtipur, Kathmandu

**Mr. Binod Lekhak**

Assistant Professor

Central Department of  
Microbiology

Tribhuvan University

Kirtipur, Kathmandu

**Dr. Tika Bahadur Karki**

Former- Director General  
Department of Food  
Technology and Quality  
Control

Babarmahal, Kathmandu

Nepal

**Date:** \_\_\_\_\_

## CERTIFICATE OF APPROVAL

On the recommendation of **Dr. Tika Bahadur Karki, Dr. Anjana Singh** and **Mr. Binod Lekhak** this dissertation work by **Ms. Poonam Thapa**, entitled “**ASSESSMENT OF HAZARD ANALYSIS CRITICAL CONTROL POINT (HACCP) OF FAST FOOD (*MOMO*) FROM RESTAURANTS OF KATHMANDU METROPOLITAN CITY WITH RESPECT TO ENVIRONMENTAL CONDITION**” has been approved for the examination and is submitted to the Tribhuvan University in partial fulfillment of the requirement for M. Sc. Degree in Microbiology.

---

Dr. Anjana Singh, Ph. D.  
Head of the Department  
Central Department of Microbiology  
Tribhuvan University  
Kirtipur, Kathmandu.

Date: \_\_\_\_\_

## BOARD OF EXAMINERS

**Recommended by:**

---

**Dr. Anjana Singh**  
Supervisor

---

**Mr. Binod Lekhak**  
Supervisor

---

**Dr. Tika Bahadur Karki**  
Supervisor

**Approved by:**

---

**Dr. Anjana Singh**  
Head of the Department

**Examined by:**

---

**Dr. Madhav Prasad Baral**  
External Examiner

---

**Ms. Shaila Basnyat**  
Internal Examiner

**Date:** \_\_\_\_\_

## ACKNOWLEDGEMENT

It is with my deep respect and gratitude; I would like to express my sincere gratefulness to my supervisor **Dr. Tika Bahadur Karki, former Director General, Department of Food Technology & Quality Control**, for his intensive guidance, generosity, tremendous constant support and invaluable suggestions during entire period of this research work.

I wish to express most sincere gratitude to my supervisor honorable **Head of Department Dr. Anjana Singh**, for her meticulous guidance, constant support, constructive suggestion and encouragement and enlightenment during whole of this research work.

I am indebted to my supervisor, **Mr. Binod Lekhak, Assistant Professor**, Central Department of Microbiology, Tribhuvan University for his guidance and constant encouragement for the completion and accomplishment of this work.

I am much obliged to **Professor Dr. Shital Raj Basnyat, Ms. Shaila Basnyat, Ms. Reshma Tuladhar**, and all the teachers and staffs of Central Department of Microbiology, Tribhuvan University.

I owe my profound gratitude to **Ms. Sushma Upadhyaya, Senior Food Research Officer, Ms. Manorama Kayastha, former Senior Food Research Officer**, and **Ms. Sangita Joshi, Food Research Officer** ; Food Hygiene Laboratory; Central Food Research Laboratory for their kind co-operation and help during entire my research works in the Laboratory.

I am sincerely indebted to **Mr. Ishwor Subedi, Food Inspector**, Central Food Research Laboratory for his invaluable help and constant moral support during the moment of hardship and accomplishment of this research work. I am also equally thankful to Mr Sudip, Mr. Toya, Mr. Narayan, Mr. Pukar, Mr. Ramesh, Mr.Durga and all of the staffs of

Central Food Research Laboratory for all their possible help and encouragement provided me during my research period.

I wish to acknowledge to my dear friend Baba, Deepika, Rajani, Chamala, Trishna, Sangeeta, Rachana, Sirjana, Jeny, Yukti, Rajdeep, Deepti, Nawalata, Manoj, Anil and all my friends for their encouragement and insightful help provided me during the time of my study.

My deepest gratitude is extended to my father, mother and family members for their inspiration, co-operation and moral support. Finally, I wish to extend my heartfelt appreciation to all the people who helped me in one way or another to complete this dissertation and the almighty God!

**Poonam Thapa**

**Date:** \_\_\_\_\_

## ABSTRACT

Economic factors and employment patterns have led to an increment in the consumption of meals outside the home. So to satisfy the basic demand of people, “Fast-food” and “Take away” restaurants have flourished in the Kathmandu Metropolitan City. In the context of Nepal, although, there has been no such report of food-borne illness incidence due to consumption of meals in the fast food restaurants, but now there is an urgency to check out the microbiological status of the fast food being served which have in a way or other impact in the health of the consumers.

Hazard Analysis Critical Control Point (HACCP) module was prepared for one of the most popular fast food *momo* (chicken *momo* and buff *momo*), common menu items of each and every fast food restaurants. For this, hazard analysis was conducted in eight different restaurants of Katmandu City by observing all the steps of preparation, monitoring time-temperature throughout the process and collecting samples of different stages of these food. The samples were assessed for total aerobic mesophilic count (TAMC), total coliform count, total *S. aureus* count, total yeast and mold count, detection of *Salmonella* spp. and *E. coli*.

Surveillance study was also conducted in those restaurants to identify the hygienic condition, holding and storage practices of those products and handling during serving. Similarly, air environment, sanitary status of the utensils and equipments like chop-board, serving plate, storage vessel of meat, mincer were too detected for the presence of pathogenic micro-organisms. The survey results revealed the fact that the knowledge of sanitation among the restaurant owners and employees were limited. The air environment of the restaurants surveyed was found to be similar in all the restaurants with *Bacillus* spp. being the most predominant one. Restaurant of site D had fecal coliform contamination in water which became the source of high coliform load in food samples. Similarly, restaurant of site G too had coliform in water which also became the cause of higher coliform load in food samples of that restaurant. The sanitary result of the utensils and equipments showed the presence of *S. aureus*.

During preparation of chicken *momo*, the highest TAMC, yeast and mold count, coliform count and *S. aureus* count were found to be  $2.8 \times 10^6$ cfu/gm,  $2.1 \times 10^3$ cfu/gm,  $1.92 \times 10^5$ cfu/gm and  $3.4 \times 10^3$ cfu/gm respectively. The samples of pickles, spices, raw *momo*, mixture of minced meat with spices and raw meat were found to be contaminated with higher microbial load.

While preparation of buff *momo*, the highest TAMC, yeast and mold count, coliform count and *S. aureus* count were found to be  $2.82 \times 10^6$ cfu/gm,  $1.9 \times 10^3$ cfu/gm,  $2.1 \times 10^5$ cfu/gm and  $2.8 \times 10^3$ cfu/gm respectively. These values and near to these values too were obtained from the samples of pickles, spices, raw *momo*, mixture of minced meat with spices and raw meat.

The organisms originally present in the raw materials were subsequently transmitted to all the preparatory stages but was not observed after steaming and hence the final

steamed product of both kinds of *momo* were free from microorganisms. From all the samples analysed, *Salmonella* spp. was absent. Thus from the above findings, it was concluded that steaming was the main Critical Control Point (CCP) which if done for proper time and temperature can eliminate all the contaminating organisms. Personal hygiene, handling and holding time-temperature are also the effective factors which have direct effect on microbial load of foods.

Though, Food Act exists in Nepal, legislative controls, regular supervision and monitoring should focus in order to combat the threat of existing or potential microbial hazards in food service establishments.

**Key Words:** HACCP, CCP, TAMC



## TABLE OF CONTENTS

|                                                          | <b>Page No.</b> |
|----------------------------------------------------------|-----------------|
| Title page                                               | i               |
| Recommendation                                           | ii              |
| Certificate of approval                                  | iii             |
| Acknowledgement                                          | v               |
| Abstract                                                 | vii             |
| Table of contents                                        | viii-ix         |
| List of abbreviations                                    | x               |
| List of tables                                           | xi              |
| List of flow charts                                      | xii             |
| List of figures                                          | xiii            |
| List of photographs                                      | xiv             |
| List of appendices                                       | xv              |
| <br>                                                     |                 |
| <b>CHAPTER I: INTRODUCTION</b>                           | <b>1-3</b>      |
| <br>                                                     |                 |
| <b>CHAPTER II: OBJECTIVES</b>                            | <b>4</b>        |
| <br>                                                     |                 |
| <b>CHAPTER III: LITERATURE REVIEW</b>                    | <b>5-29</b>     |
| 3.1 Background                                           | 5               |
| 3.1.1 Food safety hazard                                 | 5               |
| 3.1.2 Hazard analysis critical control point (HACCP)     | 6               |
| 3.1.3 Definition of terms                                | 7-8             |
| 3.1.4 HACCP principles                                   | 9-11            |
| 3.1.5 Application of HACCP principles (FAO/WHO, 1993)    | 12-16           |
| 3.1.6 Brief history and definition of <i>MOMO</i>        | 17              |
| 3.1.7 Application of HACCP approach                      | 18-29           |
| <br>                                                     |                 |
| <b>CHAPTER IV: MATERIALS AND METHODS</b>                 | <b>30-38</b>    |
| 4.1 Materials                                            | 30              |
| 4.2 Study methods                                        | 30              |
| 4.3 Surveillance study                                   | 30              |
| 4.4 Samples analysed                                     | 31              |
| 4.5 Sample collection                                    | 31              |
| 4.6 Laboratory procedures                                | 31-38           |
| 4.6.1 Preparation of food homogenate and serial dilution | 31-32           |
| 4.6.2 Enumeration of total aerobic mesophilic bacteria   | 32              |
| 4.6.3 Enumeration of coliform bacteria                   | 32              |
| 4.6.4 Enumeration of yeast and mold                      | 32              |
| 4.6.5 Incubation                                         | 33              |

|                                                                                                                        |               |
|------------------------------------------------------------------------------------------------------------------------|---------------|
| 4.6.6 Counting of colonies                                                                                             | 33            |
| 4.6.7 Detection of <i>Escherichia coli</i>                                                                             | 33-34         |
| 4.6.8 Detection of <i>Salmonella species</i>                                                                           | 34-35         |
| 4.6.9 Enumeration of <i>S. aureus</i>                                                                                  | 35            |
| 4.6.10 Pure culture for identification                                                                                 | 36            |
| 4.6.11 Plate exposure method                                                                                           | 36            |
| 4.6.12 MPN of drinking water                                                                                           | 36-37         |
| 4.6.13 Swabbing procedures                                                                                             | 38            |
| 4.6.14 Quality control for tests                                                                                       | 38            |
| <b>CHAPTER-V: 5. RESULTS</b>                                                                                           | <b>39-47</b>  |
| 5.1 Surveillance results                                                                                               | 39-42         |
| 5.1.1 Knowledge of sanitation and health education                                                                     | 39            |
| 5.1.2 Water for preparation of foods, drinking and its storage                                                         | 40            |
| 5.1.3 Handling of cooking utensils and storage of knives and chop-boards                                               | 40            |
| 5.1.4 Food preparation, storage and handling practices                                                                 | 41            |
| 5.1.5 Serving and packaging practices                                                                                  | 41            |
| 5.1.6 Personal hygiene and environmental condition                                                                     | 42            |
| 5.2 Microbiological quality of the air environment inside the different restaurants of the Kathmandu Metropolitan City | 43            |
| 5.3 Drinking water assessment of different restaurants                                                                 | 43            |
| 5.4 Sanitary survey result                                                                                             | 44            |
| 5.5 Microbiological assessment in different stages of chicken <i>momo</i> and buff <i>momo</i> preparation             | 44            |
| 5.6 Identification of pathogenic micro-organisms                                                                       | 45-46         |
| <b>CHAPTER VI: DISSCUSSION AND CONCLUSION</b>                                                                          | <b>48-63</b>  |
| 6.1 Discussion                                                                                                         | 48-62         |
| 6.2 Conclusion                                                                                                         | 63            |
| <b>CHAPTER VII: SUMMARY AND RECOMMENDATIONS</b>                                                                        | <b>64-68</b>  |
| 7.1 Summary                                                                                                            | 64-66         |
| 7.2 Recommendations                                                                                                    | 67-68         |
| <b>CHAPTER VIII: REFERENCES</b>                                                                                        | <b>69-82</b>  |
| <b>APPENDICES I–VIII</b>                                                                                               | <b>i-xxii</b> |

## LIST OF ABBREVIATIONS

|          |                                        |
|----------|----------------------------------------|
| BA       | Blood Agar                             |
| BGA      | Brilliant Green Agar                   |
| BGLB     | Brilliant Green Lactose Bile Broth     |
| BPW      | Buffered Peptone Water                 |
| CCP      | Critical Control Point                 |
| CDC      | Centre for Disease Control             |
| CFU      | Colony Forming Unit                    |
| CONS     | Coagulase Negative Staphylococci       |
| EMB      | Eosin Methylene Blue Agar              |
| FAO      | Food and Agriculture Organization      |
| FDA      | Food and Drug Administration           |
| HACCP    | Hazard Analysis Critical Control Point |
| MA       | MacConkey Agar                         |
| MPN      | Most Probable Number                   |
| MRVP     | Methyl Red Voges Proskauer             |
| NA       | Nutrient Agar                          |
| NB       | Nutrient Broth                         |
| O/F Test | Oxidative Fermentative Test            |
| PCA      | Plate Count Agar                       |
| PDA      | Potato Dextrose Agar                   |
| PVC      | Poly-vinyl Chloride                    |
| SIM      | Sulfide Indole Motility                |
| TAMC     | Total Aerobic Mesophilic Count         |
| TSIA     | Triple Sugar Iron Agar                 |
| VRBA     | Violet Red Bile Salt Agar              |
| WHO      | World Health Organization              |
| XLD      | Xylose Lysine Deoxycholate Agar        |
| YMC      | Yeast and Mold Count                   |

## LIST OF TABLES

- Table 1: Air quality assessment in the serving region in the restaurants
- Table 2: Most probable number (MPN) analysis of drinking water
- Table 3: Identification of *Salmonella* spp., *Escherichia coli*, coagulase positive *Staphylococcus aureus* in different stages of buff momo preparation
- Table 4: Identification of *Salmonella* spp., *Escherichia coli*, coagulase positive *S. aureus* in different stages of buff momo preparation
- Table 5: Hazards, critical control point, control measures and monitoring process for chicken momo and buff momo preparation process

## **LIST OF FLOW CHARTS**

Flow chart 1: The components of the HACCP system

Flow chart 2: Logistic sequence for application of HACCP (FAO, 1998)

Flow chart 3: Identification of *Escherichia coli*

Flow chart 4: Identification of *Staphylococcus aureus*

## LIST OF FIGURES

- Figure 1: Microbiological assessment of chicken *momo* at site A
- Figure 2: Microbiological assessment of buff *momo* at site A
- Figure 3: Microbiological assessment of chicken *momo* at site B
- Figure 4: Microbiological assessment of buff *momo* at site B
- Figure 5: Microbiological assessment of chicken *momo* at site C
- Figure 6: Microbiological assessment of buff *momo* at site C
- Figure 7: Microbiological assessment of chicken *momo* at site D
- Figure 8: Microbiological assessment of buff *momo* at site D
- Figure 9: Microbiological assessment of chicken *momo* at site E
- Figure 10: Microbiological assessment of buff *momo* at site E
- Figure 11: Microbiological assessment of chicken *momo* at site F
- Figure 12: Microbiological assessment of buff *momo* at site F
- Figure 13: Microbiological assessment of chicken *momo* at site G
- Figure 14: Microbiological assessment of buff *momo* at site G
- Figure 15: Microbiological assessment of chicken *momo* at site H
- Figure 16: Microbiological assessment of buff *momo* at site H

## LIST OF PHOTOGRAPHS

- Photograph 1 Growth of micro-organisms observed in total aerobic mesophilic count on Plate Count Agar (PCA) method
- Photograph 2 Growth of molds observed in yeast and mold count method on Potato Dextrose Agar (PDA) during the study
- Photograph 3 Growth of coliform count on Violet Red Bile Agar (VRBA) observed during the study
- Photograph 4 Growth of *S. aureus* observed on Mannitol Salt Agar (MSA) during the study
- Photograph 5 Isolation of pure colonies of *E. coli* on Eosin Methylene Blue Agar (EMB) observed during the study
- Photograph 6 Isolation being carried out in the laboratory during the studies

## **LIST OF APPENDICES**

**APPENDIX-I:** Questionnaire

**APPENDIX-II:**

- I. Composition and preparation of different culture media
- II. Biochemical test media
- III. Staining and test reagents

**APPENDIX-III:** Gram staining procedure

**APPENDIX-IV:**

1. Biochemical tests for identification of bacteria

**APPENDIX-V:** List of equipments and materials used during the study

**APPENDIX-VI:** MPN index table

**APPENDIX-VII:** Flow diagram of manufacturing process of buff momo and chicken momo

**APPENDIX-VIII:** Table of symbols used in food flow diagram



## Symbols used in food flow diagram

| Symbols | Interpretation                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|         | <p>Possibility that food or water initially contaminated with food borne pathogens</p> <p>Possibility of contamination with food borne pathogens from surfaces or equipment in contact with food</p> <p>Possibility of contamination with food borne pathogens from persons who handle food</p> <p>Process step</p> <p>Possible process step, but not always carried out</p> <p>Direction of flow</p> <p>Effective critical control point</p> |

|       |                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (CCP) | Not absolute critical control point                                                                                                                                                                                                                                                                                                                                                                                                     |
| CCP   | <p data-bbox="443 555 1444 667">Destruction of vegetative forms of bacteria if boiled or cooked to near boiling temperatures but spore survive</p> <p data-bbox="443 808 979 846">Possibility of survival of microorganisms</p> <p data-bbox="443 987 1134 1025">Possibility of multiplication (propagation) of bacteria</p> <p data-bbox="443 1167 775 1205">Bacterial growth unlikely</p> <p data-bbox="443 1346 536 1384">Spores</p> |
| S     |                                                                                                                                                                                                                                                                                                                                                                                                                                         |

**Table 5.** Hazards, CCP, control measures and monitoring process for “Chicken *Momo*” and “Buff *Momo*” preparation process

| Food                                     | Operation         | Hazards                                                                                                          | CCP/<br>CP | Control measures                                                                                                                                            | Monitoring procedure                                                     |
|------------------------------------------|-------------------|------------------------------------------------------------------------------------------------------------------|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| Chicken <i>Momo</i> and Buff <i>Momo</i> | Raw meat received | <i>S. aureus</i> count, yeasts and molds count, <i>E. coli</i> , <i>Salmonella</i> , <i>Shigella</i> , parasites | CP         | Obtain meat from safe source, disease free animal.<br><br>Wash meat with boiled cold water.<br><br>Avoid touching raw meat with bare hands.                 | Set purchase specifications.<br><br>Observe/smell for signs of spoilage. |
|                                          | Raw minced meat   | Contamination by handler and grinder(equipment)                                                                  | CP         | Adequate washing of hands with clean water and soap.<br><br>Use of clean mincer.                                                                            | Observe effectiveness of cleaning and sanitizing process.                |
|                                          | Spices            | <i>S. aureus</i> count, yeasts and molds count, <i>E. coli</i> , GI tract parasites.                             | CP         | Use of good quality spices.<br><br>Washing garlic, ginger, onion, coriander leaves with adequate water.<br><br>Use of clean knives, chop board and grinder. | Observe moisture and other extraneous matter on spice (plastic bag).     |

|  |                                   |                                                                                                                       |    |                                                                                                                       |                                                                                                                 |
|--|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------|----|-----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|
|  |                                   |                                                                                                                       |    | Avoid touching spices with hands touching raw meat.                                                                   | Grinder, chop board as well as knives should be washed thoroughly before and after use.                         |
|  | Mixture (minced meat with spices) | Contamination by handler and grinder(equipment)<br><br><i>S. aureus</i> count, yeasts and molds count, <i>E. coli</i> | CP | Washing hands thoroughly before and after touching mixture.<br><br>Avoid touching raw meat with bare hands.           | Observe for possibility of cross contamination<br><br>Observe storage condition of the flour bags or container. |
|  | White flour                       | Contamination by handler.                                                                                             | CP | Purchase of good quality flour and store in safe place.<br><br>Washing hands thoroughly before and after kneading the | Observe for possibility of cross contamination                                                                  |

|  |                   |                                                                                                             |    |                                                                                                                                                               |                                                                 |
|--|-------------------|-------------------------------------------------------------------------------------------------------------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|
|  | Dough preparation |                                                                                                             | CP | dough.<br>Use of safe source of water.<br>Cover the dough and keep in freezer while conditioning.<br>Keep lid on the dough prepared and put into the freezer. | Observe/smell the sign of spoilage.                             |
|  | Holding           | Bacterial multiplication and contamination from environment                                                 | CP |                                                                                                                                                               | Observe for effectiveness of cleaning procedure.                |
|  | Sheet preparation | Contamination by handler and equipment used during preparation of dough sheet.<br>Contamination by handler. | CP | Cleaning of hand model noodle sheeter and the surface used for making the sheet into circular discs.<br>Adequate washing of hands.                            | Observe for effectiveness of cleaning and sanitation procedure. |

|  |                                                  |                                                                                          |     |                                                                                                             |                                                                             |
|--|--------------------------------------------------|------------------------------------------------------------------------------------------|-----|-------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
|  | Packing/Filling mixture in circular dough sheet. | <i>S. aureus</i> count, yeasts and molds count, <i>E. coli</i> .                         | CP  | Keep in freezer until order comes.                                                                          | Observe for good sanitation practices.                                      |
|  | Raw ready to steam momo                          |                                                                                          | CP  | Washing of hands and use of clean spoons and utensils during storage and taking out of RTS-Momo from fridge | Measure temperature at geometric centre of food.                            |
|  | Cooking                                          | Total aerobic mesophilic count, coliforms, spores of GI parasites                        |     | Adequate time-temperature exposure                                                                          | Check the air quality, plates, forks, glasses used during serving of foods. |
|  | Steamed                                          | Contamination from environment, handling personnel, plates and forks used during serving | CCP | Use clean utensils during serving of foods<br>Good serving zone                                             | Check the                                                                   |

|  |       |                                                          |    |                                                                   |                                                |
|--|-------|----------------------------------------------------------|----|-------------------------------------------------------------------|------------------------------------------------|
|  | momo  |                                                          |    |                                                                   | water quality by MPN and other reliable tests. |
|  | Water | Coliforms, fecal coliforms and other pathogenic bacteria | CP | Obtain water from safe source or chlorinated water or boil water. |                                                |
|  |       |                                                          | CP |                                                                   |                                                |

RTS= Ready to steam

CP= steps at which organisms can be minimized to subsequent level.

CCP= step at which elimination of organism is possible.