

UNIVERSITI TEKNOLOGI MARA

**ANALYSIS ON THE EFFECT OF
COOKING ACTIVITIES AND
VENTILATION SYSTEM ON IAQ
AND PERCEIVED SYMPTOMS
AMONG WORKERS AT SMEs FOOD
INDUSTRY**

SITI NURSHAHIDA BINTI NAZLI

Thesis submitted in fulfilment
of the requirements for the degree of
Doctor of Philosophy
(Environmental Health and Safety)

Faculty of Health Sciences

June 2020

AUTHOR'S DECLARATION

I hereby declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Postgraduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

Name of Student : Siti Nurshahida Binti Nazli
Student I.D. No. : 2016294282
Programme : PhD in Environmental Health and Safety – HS953
Faculty : Health Sciences
Thesis Title : Analysis on the Effect of Cooking Activities and
Ventilation System on IAQ and Perceived Symptoms
Among Workers at SMEs Food Industry

Shida Mazli

Signature of Student :
Date : June 2020

ABSTRACT

Cooking activities are known to generate pollutants in the indoor environment which can cause adverse health effects to the occupants. Poor ventilation systems from inefficient mechanical means as well as limited openings would further affect the indoor air quality in an indoor environment to the level which is hazardous to health. Adverse health effects among occupants from poor indoor air quality include respiratory problems, fatigue, heavy-headed, headache, skin, eye and throat irritation, asthma or even death. This study aims to characterise the indoor air environment at small and medium industries which conducting cooking activities as lack of studies were identified in this sector. Three different cooking methods (frying, boiling and baking) were studied at 14 small and medium (SMEs) food industries selected in Pulau Pinang. The concentration level of IAQ parameters which include particulate matter in diameter 2.5, carbon dioxide, carbon monoxide, total volatile organic compounds as well as temperature and relative humidity were measured in-situ through working hours for two consecutive days using EVM-7 and IQ-610 Graywolf. The measurements were then compared to the available standards. Air change rate were measured and the IAQ determinants factors at the food SMEs were observed and identified. These include the cooking methods, types of ventilation systems adopted, type of fuel and cooking devices used and operations of exhaust fan. Besides that, questionnaire survey was administered among SMEs workers to identify the perceived IAQ symptoms. From the results, CO₂, temperature and relative humidity were found to be higher than the standard limits permitted at the three different cooking methods. To add to that, there were inadequate air change per hour which were less than 20 ACH as required by the Factory and Machinery Act (1967) which shows major problem in SMEs food industries. IAQ perceived symptoms among workers were higher in frying food SMEs although the study found that boiling SMEs had higher number of concentration of pollutants. This study provides evidence that there is correlation between the level of IAQ parameters with types of ventilation and other determinants. From the analysis of one-way ANOVA, the concentration of IAQ parameters at the SMEs food industries were related to types of cooking methods, types of ventilation system, type of fuel and cooking devices. Operation of exhaust fan however indicate no effect on CO₂ and temperature level. Through Boosted Regression Tree (BRT) analysis, CO₂ indicated the highest pollutant to cause complaints by workers followed by CO, temperature and relative humidity. The IAQ in SMEs food industries were poor due to inadequate ventilation systems which affecting the health of the workers. The study indicates the need of immediate corrective actions on indoor air quality and ventilation system towards SMEs food industry. This study provides a preliminary research towards providing a proper procedure and guideline for SMEs food industries. This study also suggests that future research to focus on boiling and frying SMEs with CO₂, CO, temperature and relative humidity to be given emphasize. Simulation study related to these parameters might also be considered.

ACKNOWLEDGEMENT

In the name of Allah s.w.t., the Most Gracious and the Most Merciful. Alhamdulillah all praises to Allah for the strength, courage and blessing throughout completing this thesis. for giving me the opportunity to embark on my PhD and for completing this long and challenging journey successfully.

First of all, I would like to take this opportunity to express my gratitude to my supervisor, Ts. Dr. Azli Bin Abd Razak for giving me the guidances, advices, motivations, invaluable comments and suggestions throughout my PhD study. My sincere gratitude is also extended to my co-supervisor Associate Professor Dr. Ahmad Zia Ul-Saufie Bin Mohamad Japeri for the advices, time and input for my data analysis. My appreciation also goes to Dr. Shantakumari Rajan for her help. This research also received helps from Penang Regional Department (PERDA) for sampling purposes. Thus, this acknowledgement also goes to them.

I also wish to thank my beloved husband, Mr. Mohd Khairul Anuar Bin Ab Rahim Yang for his continuous support, love, patience and advices from the start of my PhD study until the end. To my children Fayyadh Rajid, Aludra Ameena, Fayyim Rafsal and Adurra Ayeesha, this thesis is also dedicated to all of you for always being there for me. I also thanked my family for their constant moral support, encouragement and love.

TABLE OF CONTENTS

	Page
CONFIRMATION BY PANEL OF EXAMINERS	ii
AUTHOR'S DECLARATION	iii
ABSTRACT	iv
ACKNOWLEDGEMENT	v
TABLE OF CONTENTS	vi
LIST OF TABLES	xi
LIST OF FIGURES	xiv
LIST OF ABBREVIATIONS	xv
CHAPTER ONE: INTRODUCTION	1
1.1 Research Background	1
1.2 Problem Statement	4
1.3 Research Objectives	7
1.3.1 General Objective	7
1.3.2 Specific Objectives	7
1.4 Scope and Limitation of the Study	8
1.5 Significance of the Study	10
1.6 Outline of Thesis Structure	13
CHAPTER TWO: LITERATURE REVIEW	14
2.1 Introduction	14
2.2 Small and Medium Industries Food Sectors in Malaysia	14
2.3 The Importance of a Good Indoor Air Quality	16
2.4 Indoor Air Pollutants and the Evidence on Emission Sources and Effects	17
2.4.1 Particulate Matter (PM2.5)	17
2.4.1.1 <i>Evidence of indoor PM2.5 sources and emissions</i>	18
2.4.1.2 <i>Evidence of indoor PM2.5 health effects</i>	20
2.4.2 Carbon Dioxide (CO2)	20