

**THE IMPACT OF HACCP IMPLEMENTATION ON THE
PERFORMANCE OF MALAYSIAN FOOD INDUSTRIES**

by

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TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENTS	ii
TABLE OF CONTENTS	iii
LIST OF TABLES	ix
LIST OF FIGURES	xi
LIST OF ABBREVIATIONS	xii
LIST OF APPENDICES	xiii
ABSTRAK	xiv
ABSTRACT	xv

CHAPTER ONE: INTRODUCTION

1.0	Introduction	1
1.1	Research Background	2
1.2	Research Problem	5
1.3	Research Questions	7
1.4	Research Objectives	8
1.5	Scope of the Study	9
1.6	Assumptions	9
1.7	Significance and Justification of the Study	9
1.8	Thesis Organisation	11

CHAPTER TWO: LITERATURE REVIEW

2.0	Introduction	12
2.1	Previous Studies on the Impact of HACCP Implementation	12

2.2	Background on HACCP System	14
2.3	HACCP System	16
2.4	Prerequisite Program for HACCP	20
2.4.1	Good Manufacturing Practices	20
2.5	The International Trade in Food – A Brief Introduction	23
2.5.1	The World Food Trade Before the Uruguay Round Agreements	26
2.5.2	The Uruguay Round Agreements	27
	A. The TBT Agreement	29
	B. The SPS Agreement	31
2.5.3	Codex Alimentarius and the World Trade Organisation	33
2.6	The Current Situation in Malaysia	35
2.6.1	HACCP Certification for Malaysian Food Industries	37
2.6.2	Definition of SMEs in Malaysia	41
2.6.3	Development of SMEs in Malaysia	41
2.6.4	SIRIM	42
2.6.5	SIRIM's Integrated ISO 9000/HACCP Certification	43
2.7	The International Organization for Standardization (ISO)	43
2.7.1	The Certification Process	46
2.7.2	ISO 22000	46
2.8	Risk Analysis	47
2.8.1	Risk Assessment	48
2.8.2	Risk Management	49
2.8.3	Risk Communication	50
2.9	Summary	51

CHAPTER 3: METHODOLOGY	52
3.0 Introduction	52
3.1 Overall Research Design	52
3.1.1 Research Approach	54
3.1.2 Target Population and Sample	56
3.1.3 Questionnaire Development	57
3.2 Survey Instruments	59
3.2.1 Justification for the Questionnaire Constructs	62
3.2.1.1 Section One: Company Profile	63
3.2.1.2 Section Two: HA, CCP, CL, MON, CA, VER,REC, GMP and TR	64
3.3 Questionnaire Data Collection	65
3.4 Secondary Data Collection	66
3.5 Factory Audits	68
3.5.1 Microbial Evaluation of Hygiene and Sanitation at Audited Factories	70
3.6 Data Analysis Techniques	74
3.6.1 Descriptive Statistics	75
3.6.2 Multiple Regression Analysis	76
3.6.3 Correlation Analysis	77
3.7 Summary of Chapter 3	78

CHAPTER 4: RESULTS AND DISCUSSION	79
4.0 Results of the Study	79
4.1 Response Rate	79
4.2 Measure of Reliability	80
4.2.1 Reliability Analysis	80
4.3 Respondents' Profile	82
4.3.1 Position of Respondents in the Company	83
4.3.2 Company Characteristics	83
4.3.2.1 Organisation Status	83
4.3.2.2 Industry Classification of Companies	83
4.3.2.3 Company Size	84
4.3.2.4 Annual sales turnover	84
4.3.2.5 Period of Certification	84
4.3.2.6 Other Quality Systems Besides HACCP	84
4.4 Descriptive Analysis	85
4.4.1 Descriptive Analysis for Hazard Analysis (N=15)	86
4.4.2 Descriptive Analysis for CCPs (N=15)	86
4.4.3 Descriptive analysis for Monitoring (N=15)	87
4.4.4 Descriptive analysis for Corrective Actions	87
4.4.5 Descriptive Analysis for GMP (N=15)	88
4.5 Comparison between Secondary Data and Questionnaire Responses	89

4.6	Hypotheses	92
4.7	Factory Audits	93
4.8	Measure of Reliability	93
	4.8.1 Reliability Analysis	93
4.9	Company Profile	94
	4.9.1 Company Characteristics	95
	4.9.1.1 Organisation Status	95
	4.9.1.2 Classification of Companies based on SMIDEC	95
	4.9.1.3 Period of Certification	96
4.10	Descriptive Analysis	96
	4.10.1 Descriptive Analysis of GMP Dimensions (N=15)	97
	4.10.2 Descriptive Statistics of Training (N=15)	98
	4.10.3 Descriptive Analysis of Laboratory Procedures (N=15)	99
	4.10.4 Descriptive Analysis of HACCP Documents (N=15)	100
	4.10.5 Descriptive Analysis of HACCP Team and Internal Auditors (N=15)	101
	4.10.6 Descriptive Analysis of Hazard Analysis Worksheet/HACCP Plan Summary (N=15)	101
	4.10.7 Descriptive Analysis of Verification (N=15)	102
	4.10.8 Descriptive Analysis of Records (N=15)	103
4.11	Hypothesis Testing	104
	4.11.1 Relationship Between HACCP Implementation and Gross Profit	104

4.11.2	Relationship Between HACCP Implementation and Operations Cost	106
4.11.3	Relationship Between HACCP Implementation and Microbiological Quality	108
4.12	Correlation Analysis for Secondary Data	110
4.13	Summary	112
CHAPTER 5: CONCLUSION		114
5.0	Recapitulation of the Study	114
5.1	Discussion	115
5.1.1	Impact of HACCP Implementation on Gross Profit	115
5.1.2	Impact of HACCP Implementation on Operations Costs	119
5.1.3	Impact of HACCP Implementation of Microbiological Quality	120
5.1.4	Correlation between company size, ownership and geographical location with HACCP performance	122
5.2	Study Limitations	123
5.3	Recommendations for Future Research	124
5.4	Conclusion	125
BIBLIOGRAPHY		127
APPENDICES		137

LIST OF TABLES

	Page	
Table 2.1	HACCP-Certified Companies in Malaysia	38
Table 2.2	Status of HACCP Certification Application	40
Table 3.1	Overall Layout of Questionnaire	61
Table 3.2	Demographic Variables	63
Table 3.3	Sampling Plan for Factory Audit Swab Test	69
Table 3.4	Different Techniques Utilized from SPSS Software	75
Table 3.5	Interpretations of Various Levels of Strength of the Correlation	77
Table 4.1	Cronbach's Alpha for Questionnaire Results	81
Table 4.2	Respondents' background information (N=15)	82
Table 4.3	Descriptive statistics for the main constructs (N=15)	86
Table 4.4	Descriptive Analysis for Hazard Analysis (N=15)	87
Table 4.5	Descriptive Analysis for CCPs	88
Table 4.6	Descriptive analysis for Monitoring (N=15)	88
Table 4.7	Descriptive analysis for Corrective Actions (N=15)	88
Table 4.8	Descriptive analysis for GMP (N=15)	89
Table 4.9	Questionnaire Layout and Outline	90
Table 4.10	Research Hypotheses	93
Table 4.11	Reliability Analysis for Observed NCRs during Factory Audit.	94
Table 4.12	Background information of the audited factories (N=15)	95
Table 4.13	Descriptive Analysis for the Main Constructs (N=15)	98
Table 4.13	Descriptive Analysis of GMP Dimensions (N=15)	99
Table 4.14	Descriptive Analysis of Training (N=15)	99

		Page
Table 4.15	Descriptive Analysis of Laboratory Procedures (N=15)	100
Table 4.16	Descriptive Analysis of HACCP Documents (N=15)	101
Table 4.17	Descriptive Analysis of HACCP Team and Internal Auditors (N=15)	102
Table 4.18	Descriptive Analysis of Hazard Analysis Worksheet/HACCP Plan Summary (N=15)	102
Table 4.19	Descriptive Analysis of Verification (N=15)	103
Table 4.20	Descriptive Analysis of Records (N=15)	104
Table 4.21	Results for the Multiple Regression Analysis of the Impact of HACCP Implementation to Gross Profit	105
Table 4.22	Results for the Multiple Regression Analysis of the Impact of HACCP to Operations Cost.	107
Table 4.23	The Results of Multiple Regression Analysis of GMP to Microbiological Quality (APC)	109
Table 4.24	The Results of Multiple Regression Analysis of GMP to Microbiological Quality (<i>Escherichia coli</i>)	109
Table 4.25	Summary of Hypothesis Testing	113
Table 5.1	Decreased <i>Salmonella</i> Level for Selected Meat and Poultry Products	121

LIST OF FIGURES

		Page
Figure 2.1	Risk Analysis Framework	38
Figure 3.1	Questionnaire Design	58
Figure 3.2	Flow Chart of Study Methodology	78
Figure 4.5	Multiple Regression Analysis of HACCP Implementation to Gross Profit	105
Figure 4.6	Multiple Regression Analysis of HACCP Implementation to Operations Cost	107

LIST OF ABBREVIATIONS

APC	Aerobic Plate Count
BRC	British Retail Consortium
CAC	Codex Alimentarius Commission
CAR	Corrective Action Request
CCP	Critical Control Point
CL	Critical Limits
EU	European Union
FAO	Food and Agriculture Organization
FQCD	Food and Quality Control Division, Ministry of Health
GAP	Good Agricultural Practices
GHP	Good Hygienic Practices
GMP	Good Manufacturing Practices
HACCP	Hazard Analysis and Critical Control Point (as defined in Malaysian Standard MS 1480:1999)
IRMA	International Raw Materials Assurance Scheme
ISO	International Organization for Standardization
MOH	Ministry of Health
NCR	Non-conformance Report
SGF	Schutzgemeinschaft der Fruchtsaft-Industrie
SME	Small and Medium Enterprises
SPS	Sanitary and Phytosanitary Measures
SPSS	Statistical Package for Social Science
SOP	Standard Operating Procedure
TBT	Technical Barriers to Trade
TQM	Total Quality Management
WHO	World Health Organization

LIST OF APPENDICES

- Appendix A Survey Questionnaire and Cover Letter
- Appendix B Signed Agreements with Ministry of Health
- Appendix C Comparison of Questionnaire Responses with MOH Database
- Appendix D Checklist for HACCP Surveillance Audit
- Appendix E Summary of the Main and Corollary Hypotheses
- Appendix F Reliability Analysis for Questionnaire Study
- Appendix G Descriptive Statistics for Main Variables in Questionnaire Study
- Appendix H Reliability Analysis for Factory Audit Data
- Appendix I Descriptive Analysis from Factory Audit Data (Main Constructs)
- Appendix J Descriptive Analysis from Factory Audit Data (Individual Dimensions)
- Appendix K Relationship Between HACCP Implementation and Gross Profit
- Appendix L Relationship Between HACCP Implementation and Operations Cost
- Appendix M Microbial Data 1
- Appendix N Microbial Data 2
- Appendix O Correlation Analysis for Secondary Data

THE IMPACT OF HACCP IMPLEMENTATION ON THE PERFORMANCE OF MALAYSIAN FOOD INDUSTRIES

ABSTRACT

Malaysia's economy, like that of many other developing countries is heavily dependent on the export of a variety of commodities among the most important being processed food products. This study was undertaken to study the impact of HACCP implementation on local food industries by analyzing the correlation between HACCP implementation and a company's financial performance in terms of overall gross profit, operations cost, and food microbial quality. The impact of HACCP was also analysed regarding Small and Medium Industries compared with Large Industries, locally-owned enterprises versus multinationals and food industries in West Malaysia versus East Malaysia. The study was conducted in three phases; a questionnaire developed for preliminary information gathering, secondary data gathering at the Food Quality Control Division of the Ministry of Health and primary data was then obtained by accompanying auditors from the Ministry of Health during surveillance audits to 15 food processing factories. HACCP implementation was found to have a positive impact on company gross profit, operations costs and was effective in reducing average microbiological count at various food contact surfaces on the production floor. SMIs were found to have some problems in implementing HACCP compared to larger multinational or joint-venture companies but overall, they are performing relatively well.

KESAN IMPLEMENTASI HACCP TERHADAP PRESTASI INDUSTRI MAKANAN TEMPATAN

ABSTRAK

Ekonomi Malaysia, seperti kebanyakan negara yang sedang membangun, amat bergantung kepada eksport pelbagai komoditi. Antara komoditi-komoditi ini adalah produk makanan yang diproses. Kajian ini bertujuan mengkaji kesan pelaksanaan HACCP terhadap industri makanan tempatan melalui korelasi antara implementasi HACCP dan prestasi sesebuah syarikat dari segi profit, kos operasi dan kualiti makanan dari segi mikrobiologi. Kesan HACCP juga dianalisis terhadap Industri Kecil dan Sederhana berbanding dengan Industri Besar, syarikat tempatan berbanding syarikat antarabangsa dan syarikat makanan di Malaysia Barat berbanding Malaysia Timur. Kajian telah dilaksanakan mengikut tiga fasa; borang soal selidik untuk mendapat maklumat awal, kajian data daripada Bahagian Kawalan Mutu Makanan Kementerian Kesihatan, dan semasa audit bersama para auditor daripada Kementerian Kesihatan ke 15 buah kilang pemprosesan makanan. Implementasi HACCP didapati memberi kesan positif kepada keuntungan, kos operasi syarikat dan dapat mengurangkan bilangan mikrob di kawasan pemprosesan makanan. Industri Kecil dan Sederhana didapati menghadapi masalah implementasi HACCP berbanding syarikat-syarikat antarabangsa tetapi kesimpulannya, industri-industri ini memang mempunyai prestasi yang baik.

CHAPTER ONE

INTRODUCTION TO THE STUDY

1.0 Introduction

Rapid urbanisation and reform in developing countries have changed the market for food commodities. Countries like Malaysia now find themselves participating in a global trade dealing in a wide range of food products. Even perishable products such as raw seafood and fresh vegetables can be transported over long distances and producers increasingly experience competition from faraway competitors.

Consumers consequently are faced with food or food ingredients that may derive from distant countries or continents, and with a less transparent food supply. This has led to food quality and safety concerns.

In most of the developing world basic food safety rules accommodate these risks, through buying, cooking, preserving and social pressure on food processors and marketers. However, with increasing globalisation of the food supply the transparency of short market chains may be lost, and consumers are increasingly dependent on specialized services to guarantee safe food. For international trade, the Hazard Analysis and Critical Control Point (HACCP) system has now firmly established itself as an important component of safety assurances for food products sold in the worldwide market.

The European Union (EU) first initiated the requirement for HACCP for the import and export of fish and fish products to the EU countries in 1996. The United States likewise had also required HACCP for imported fish and fishery products to the country in 1997 (FDA, 1998). Development in food safety requirements motivated exporting countries to consider the implementation of HACCP for their food products. Although the implementation of HACCP is on a

voluntary basis, the future of Malaysian seafood products in the international trade is highly linked with our ability to comply with the food safety requirements imposed by the importing countries. As an exporting country, Malaysia must be able to meet the mandatory requirements of importing countries.

This study investigated the performance of Malaysian food manufacturers by exploring the relationship between the level of HACCP implementation and the companies' size, ownership and geographical location. Additionally, a comparison was made between HACCP data collected from each company via questionnaires and data recorded by external auditors. It is expected that respondents may often try to portray their company in a better light and this comparison will allow a more accurate picture of the situation among Malaysian food manufacturers. Lastly, the data was further analysed using the companies' annual Gross Profit and Cost of Operations to explore their relationship with their level of HACCP implementation. Microbial indicators were used to determine if a company was successful at implementing Good Manufacturing Practices (GMP).

This chapter provides an overview of the research, followed by a discussion of the research problem, research questions, definition of the terminology used, as well as the objectives, scope, assumptions, significance and justifications of the study.

Additionally, the thesis organisation is detailed at the end of this chapter.

1.1 Research Background

Over the past 5 years there has been an increase in the number of Malaysian food manufacturers with HACCP certification. HACCP is becoming a major issue in the Malaysian food industry primarily due to demands from importing countries such as the United States and the European Union (EU). As

of December 1997 (FDA, 1998), the United States government has been requiring seafood processors to develop and implement HACCP systems for imported fish and fishery products. The European Union has similarly issued Directive 91/493/EEC (22/7/1991) and Directive 94/356/EC (20/5/1994), requiring all manufacturers exporting seafood products to the EU to implement HACCP systems. Malaysian food manufacturers as such are compelled to respect the demands of importing countries or risk rejection of their seafood products.

Since January 1995, Malaysia has been a member of the World Trade Organization (WTO), which currently has a membership of 148 members, and has attached to it several Agreements and Ministerial Decisions and Declarations including the Agreement on the Application of Sanitary and Sanitary and Phytosanitary Measures (SPS Agreement) and the revised Agreement on Technical Barriers to Trade (TBT Agreement). Both those Agreements are related to the trade in food with the SPS Agreement specifically related to human health and safety. Malaysian exporters have no choice but to comply with the demands of importing countries under those Agreements (FAO, 1999).

Malaysian food industries consist of 5,565 food manufacturers and 172,252 food service entities (stalls, restaurants, etc). They contribute 11.9 percent to GDP (Selamat et al., 2003). Of these, only 74 companies have HACCP certification (as of March 2004) with 41 companies exporting to the EU. Predictably, these 41 companies are all involved in the seafood industry. As is typical of Malaysia and other countries in the region, the majority of local industries can be classified as Small and Medium Enterprises (SME).

In the year 2004, Malaysian fishery exports were estimated at 361 million US dollars (Shamsudin, 2005). This constituted an increase from 2003 where 359 million US dollars worth was exported. This thesis will attempt to determine

whether there is a link between the adoption of HACCP among Malaysian food manufacturers and improved performance.

Despite HACCP certification, some companies have been experiencing rejections due to the presence of *Vibrio parahaemolyticus* in raw frozen black tiger prawns, *Penaeus monodon* (MOH, 2003). In other words, implementing HACCP does not guarantee that a given product will *not* be rejected by the importing country. This leads to the questions; “What is the impact of HACCP implementation on Malaysian food industries?” and “Are large multinationals in urban areas outperforming SMIs in less-developed areas in their implementation of HACCP?” This thesis aims to answer that question as well as provide a clearer view of the actual situation in implementing HACCP and GMP in Malaysia.

To date, no large-scale study has been conducted to study the impact of HACCP implementation on Malaysian food industries. Furthermore, no research has been conducted based on statistical information such as percentage value of seafood exports. No study in the past had taken into account bacteriological indicators as a means to assess, control and ensure a particular Malaysian food processing outlet is effectively implementing its HACCP and GMP programme. This research will attempt to link adoption of the HACCP system with competitiveness of Malaysian products based on such criteria as market share and profits. Additionally, an evaluation of several local seafood processing plants was carried out based on microbiological indicators to determine the hygienic conditions as practiced by the employees. A particular HACCP program cannot be effectively applied if hygienic conditions are not in place. Microbial analysis was employed as a tool to help determine the actual hygiene conditions of the working environment in such factories and how committed the management is to actually implementing and maintaining HACCP and its prerequisite programmes.

1.2 Research Problem

The problem can be discussed according to different viewpoints.

Firstly, HACCP has been implemented by the Malaysian Ministry of Health (MOH) since 1998 (Department of Fisheries, 1999). Yet no significant research has so far been conducted on the impact or effects of HACCP on Malaysian companies. Most studies conducted in America and Europe focused on the economic impact of HACCP implementation. Crutchfield et al. (1997) studied the cost of HACCP implementation in terms of industry structure, wages, modification costs, costs of training, supply and demand conditions, and the timing of implementation. Others (Knutson et al., 1995; Jensen et al., 1998) had used different assumptions and produced different estimates of the costs of implementing a HACCP programme. Deodhar (2003) studied the set-up cost and operating cost for HACCP programmes among various food industries in India. However, some recent studies have focused on the impact of HACCP adoption on gains in trade (Zaibet, 2000; Alpay et al., 2001). Zaibet (2000) analysed the relationship between compliance to HACCP and the competitiveness of the Oman fish processing industry, using an export model, in which firm export penetration index (measured as the proportion of export volume in total production) is a function of the status of HACCP adoption, sanitation requirement, labor (number of employees), and capital stock. Results of this study found that HACCP adoption had a positive impact on export performance. Alpay et al. (2001) studied the impact of HACCP and other quality control systems on the export performance of Turkish food processing firms. Export value is specified as a function of the compliance with quality and safety standards, HACCP adoption levels, the compliance with environmental standards, the degree of vertical integration, and firm experience in the export

markets. Although using a different approach than Zaibet (2000), the study also reveals a positive relationship between HACCP adoption and export performance.

An approach similar to Zaibet and Alpay et al. can be taken in which the impact of HACCP on the financial performance of Malaysian food processing firms is studied. Overall company gross profit and operations cost can be specified as a function of the compliance with HACCP adoption levels. The question then arises, “Does compliance to HACCP generate high financial performance (in terms of overall gross profit and operations costs)?”

Secondly, how can the level of HACCP adoption practised by a company be determined? HACCP Auditors use a system in which non-conformances in a company’s HACCP system are classed into various categories to determine which non-conformity takes precedence when the company wishes to correct the error. An approach can be taken in which a 5-point Likert scale is used to represent each category (e.g.: scale 1: no NCR, scale 2: Observation, Scale 3: Minor NCR, scale 4: Major NCR and scale 5: Serious NCR). Thus, the level of HACCP adoption can now be mathematically calculated. Once calculated, the overall company gross profit and operations cost can be specified as a function of the compliance with HACCP adoption levels (already measured by a Likert scale). No empirical studies have been done exploring this relationship. This study stipulates HACCP adoption levels as the main factor for the financial performance of companies exporting to countries where HACCP certification is mandatory for imported goods.

Thirdly, are locally-owned SMEs experiencing some difficulty in implementing HACCP compared with larger multinational companies? Data from the MOH can be analysed to provide us with an accurate answer. HACCP

adoption levels can be a function of company size, ownership and geographical location. This allows the correlation between said factors and HACCP performance.

Finally, how can we ascertain the validity and reliability of an anonymous questionnaire? Can questionnaires truly give accurate information? In most studies involving questionnaires, the researchers **assume** that the respondents are able and willing to provide accurate responses to the questions asked (Carr et al., 1997). For this particular study no such assumption is made because accurate data is available for comparison. With the availability of audit data from the MOH, we can compare the provided responses with actual records written by external auditors.

1.3 Research Questions

Based on an extensive literature review, the following research questions have been proposed related to the implementation of HACCP in Malaysian food manufacturing companies:

Question 1: What is the impact of HACCP implementation on a company's financial performance in terms of overall gross profit?

Question 2: What is the impact of HACCP implementation on a company's financial performance in terms of operations cost?

Question 3: What is the impact of HACCP implementation on the microbiological quality of a factory's food processing area and can it be used to determine the effectiveness of its GMP programme?

Question 4: Are SMIs facing more problems regarding HACCP implementation compared with larger companies?

Question 5: Are locally-owned enterprises facing more problems regarding HACCP implementation compared with multinationals?

Question 6: Is there a relationship between a company's location and its performance in implementing HACCP?

1.4 **Research Objectives**

In addressing the research problem and answering the research questions, this study seeks to achieve seven principle research objectives:

- To investigate the effects of HACCP on overall gross profit
- To investigate the effects of HACCP on operations costs
- To investigate the effects of GMP implementation on microbiological quality
- To explore the performance of Small and Medium-Sized Industries versus large-scale industries in HACCP implementation
- To explore the performance of local companies versus multinationals in the terms of number and type of NCRs received during audit
- To explore to explore the relationship between geographical location and performance of HACCP-certified companies in terms number and type of NCRs received during audit.
- To compare questionnaire results with actual audit data to assess respondents' truthfulness (additional study; does not influence hypothesis testing)

1.5 Scope of the Study

This study investigates the impact of HACCP on overall gross profit, operations profit and microbiological quality (Questions 1, 2 and 3) and the relationship between company size, status and location with regards to HACCP performance (Questions 4, 5 and 6).

In order to investigate Questions 1, 2 and 3 permission was obtained from MOH allowing the researcher to a trained auditor during surveillance audit at 15 separate food producing outlets. Information pertaining to financial performance of the companies was obtained with permission from MOH while microbiological testing and hygiene evaluation of the processing areas were also carried out.

Questions 4, 5, and 6 were investigated by analysing recorded audit data obtained with the permission of MOH. Additionally, a separate questionnaire (see Appendix A) was developed to study the validity and reliability of given responses by comparing questionnaire results with the actual audit data obtained from the MOH.

1.6 Assumptions

The following assumptions were taken in consideration in this study: Firstly, the respondent to the questionnaire have in-depth knowledge of HACCP and GMP. Secondly, the perception of the respondents is representative of the organisation.

1.7 Significance and Justification of the Study

Research about the impact of HACCP implementation is important and useful. This study is expected to contribute to the theory and practice of HACCP. The proposed questions in this study are important for at least 3 reasons.

(i) This study is also vital because it discusses and assesses the performance of local SMIs versus larger multinational companies. It is hoped that this study can contribute to the body of knowledge on HACCP and GMP as a whole.

(ii) The impact of HACCP implementation on gains in trade can be determined. Zaibet (2000) analysed the relationship between compliance to HACCP and the competitiveness of the Oman fish processing industry, using an export model. Similarly, a study on Malaysian food industries can provide a clearer understanding of the impact of HACCP on financial performance in certified exporting companies.

(iii) The validity and usefulness of questionnaires can be determined in this study. The accuracy of information provided has always been assumed by researchers; this is the first such study involving questionnaires where such an assumption is unnecessary.

Results of this project will give useful information for the HACCP and GMP training courses for processors in Malaysia. It will help business leaders, quality practitioners and the government authorities to determine the future planning of HACCP adoption and certification in Malaysia and its relevance in enhancing international trade. Therefore, this study could be a contribution to the accumulated knowledge on quality control systems in the food manufacturing industry.

1.8 Thesis Organisation

The thesis is divided into five chapters. The first chapter gives a brief description of the research. It provides an overview of the research background, research problems, research questions, objectives of the thesis, scope of the study, its assumptions, justifications and significance.

The second chapter provides an extensive literature related to HACCP in Malaysia and elsewhere. It also discusses other quality standards like ISO 9001:2000 as well as prerequisite programmes for HACCP such as GMP and Sanitation Standard Operating Procedures (SSOP).

Chapter three describes the research methodology. This includes research design, population and sample, questionnaire development, secondary data collection, factory audit and microbial sample collection.

Chapter four shows the findings of the study. This includes descriptive statistics and the results of hypothesis testing as well as comparisons between questionnaire response and actual recorded audit data.

Chapter five presents discussions of the whole study. A brief review and summary of the research objectives and the accomplishments and main conclusions were provided. The developed framework, limitations, implications of the research and recommendations for future study were further explained.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

The purpose of this chapter is to explore and summarise the related literature on HACCP implementation in Malaysia and the international food trade in general. This literature review provided the basis for developing the research instruments and final analysis. The initial sources for this chapter came from books, journals, dissertations, proceedings and information from the Internet.

2.1 Previous Studies on the impact of HACCP Implementation

Previous studies on the impact of quality management systems on overall company performance are merely based on case studies or are descriptive in nature. Martinez-Lorente and Martinez-Costa (2004) reported similar findings for their study on ISO 9000. Withers and Ebrahimpour (2000) state, "In general, these studies are speculative, impressionistic, anecdotal and based on the experiences of a single company".

Some researchers (Santos and Escanciano, 2002) found a positive link between the implementation of quality management systems (HACCP, ISO 9000, TQM etc.). Singels et al. (2001) found that ISO 9000 implementation has no effect on organisational performance.

In the literature, the firm level determinants of export performance have been studied extensively. Recent surveys of this literature have been carried out by Katsiekas et al. (1996) and Zou and Stan (1998). Many different variables have been employed but performance variables related to compliance with safety and quality standards were not explicitly introduced. Recently, Alpay et al. (2001)

conducted face to face interviews with 100 firms in 5 different food subsectors in Turkey and then collected data to determine (i) whether the compliance with safety and quality standards (such as HACCP) is rewarded in the EU market, (ii) whether the impact of strong vertical integration and care for environmental quality is positively related to export performance, and (iii) whether there are differences across subsectors or not. The analysis of their survey data showed that the vertical integration, environmental performance and quality indices have significant positive impact on the export performance of firms. The results are similar across subsectors and across years included in our study.

Zaibet (2000) analysed the relationship between compliance to HACCP and the competitiveness of the Oman fish processing industry using an export model, in which firm export penetration index (measured as the proportion of export volume in total production) is a function of the status of HACCP adoption, sanitation requirement, labor (number of employees), and capital stock. Results of this study found that HACCP adoption had a positive impact on export performance.

In summary, the research by previous researchers showed great intuition. However similar studies on the impact of compliance to HACCP and other quality management systems on Malaysian food processors has yet to be done. This research will further add to the existing data and may prove an invaluable guide to those who wish to further understand the impact of HACCP implementation and compliance towards local food industries.

2.2 Background on HACCP

In the 1960's, the Pillsbury Company in cooperation with the National Aeronautic and Space Administration (NASA) first constructed HACCP to describe the systematic approach to food safety. The goal of the programme was to come as close to 100% assurance as possible that the food produced for space use would not be contaminated with bacterial or viral pathogens, toxins, chemicals or physical hazards that could cause an illness or injury (Pierson and Corlett, 1992).

In 1971, the HACCP concept was first presented at the first National Conference on Food Protection. During the 1970's and 1980's a number of the food companies requested information to help them establish their own HACCP programmes. In 1985, USA National Academy of Sciences (NAS) recommended the HACCP system in the publication *Evaluation of the role of microbiological criteria for food and food ingredients* (Pierson and Corlett, 1992). The Advisory Committee on Microbiological Criteria for food developed material elaborated principles of this food safety and quality management system based on NAS recommendation and provided guidance for their application for food processing operations. HACCP was recommended in both food regulator and industry because it was the most effective and efficient means of assuring the safety of the food supply (Limpus, 1997).

In 1990 the Codex Alimentarius Commission (CAC) on Food Hygiene started to prepare a draft guideline for the application of HACCP system (Huss, 1994). In the last ten years, HACCP has become widely used. It is now a legislative requirement in USA, Canada and EU-countries. Some countries such as Australia, New Zealand, Canada, Japan, Egypt, South Africa, and many

others have also adopted or are considering food safety control systems based on HACCP.

In Canada, the Quality Management Program (QMP) was established as a mandatory programme for food inspection in February 1992. It was based on HACCP principles. The QMP uses the principles of HACCP for ensuring safe food production, to provide a high level of assurance that fish and seafood products produced in Canada are safe and wholesome to eat (CFIA 2001).

In 1995, The United State Food and Drug Administration (FDA) published final regulations that require processors of fish and fishery products to develop and implement HACCP systems for their operations including imported fish and fishery products. Those regulations became effective on December 18, 1997 (FDA 1998).

The European Union has issued the Directive 91/493/EEC (22/7/1991) and the Directive 94/356/EC (20/5/1994), which requires all seafood processing establishments that export their products to EU market to carry out HACCP system called "Own check".

In the past five years, many Asian countries including Malaysia have implemented national HACCP programmes for their fish processing industry in line with international trends. Hazard Analysis and Critical Control Point (HACCP) and Good Manufacturing Practices (GMP) are the more prevalent food safety systems being adopted by the food industry in Malaysia. GMP is currently used as a pre-requisite to HACCP.

HACCP in Malaysia is currently a voluntary exercise, except for seafood exported to the United States and the European Union. In 2001, the Ministry of Health published Guidelines for HACCP Certification, Guidelines for HACCP Compliance Audit, Guidelines for Certification of HACCP Compliance Auditor, and Guidelines for HACCP Surveillance Audit.

2.3 HACCP System

Codex Alimentarius states that the HACCP system, which is science based and systematic, identifies specific hazards and measures for their control to ensure the safety of food. HACCP is a tool to assess hazards and establish control systems by focusing on prevention rather than relying mainly on end-product testing (Codex 1997). HACCP systems are designed to prevent and control food-safety hazards from the time a factory receives raw material through production to distribution to the consumer (NSHA 1997).

The HACCP approach is to control problems before they happen during processing and/or serving.

Effective HACCP implementation is very important to avoid the adverse human health and economic consequences of food-borne illness or foodborne injury.

There are seven discrete activities that are necessary to establish, implement and maintain a HACCP plan, and these are referred to as the 'seven principles' of HACCP. The following is a brief explanation taken from *Hazards analysis and critical control point (HACCP) system and guidelines for its application*, published by the Codex Alimentarius Commission in 1997.

Principle 1

Conduct a hazard analysis.

Identify hazards and assess the risks associated with them at each step in the commodity system. Describe possible control measures.

Principle 2

Determine the Critical Control Points (CCPs)

A critical control point is a step at which control can be applied and is essential to prevent or eliminate a food safety hazard, or reduce it to an acceptable level.

Principle 3

Establish critical limits.

Each control measure associated with a CCP must have an associated critical limit which separates the acceptable from the unacceptable control parameter.

Principle 4

Establish a monitoring system

Monitoring is the scheduled measurement or observation at a CCP to assess whether the step is under control, i.e. within the critical limit(s) specified in Principle 3.

Principle 5

Establish a procedure for corrective action, when monitoring at a CCP indicates a deviation from an established critical limit.

Principle 6

Establish procedures for verification to confirm the effectiveness of the HACCP plan.

Such procedures include auditing of the HACCP plan to review deviations and product dispositions, and random sampling and checking to validate the whole plan.

Principle 7

Establish documentation concerning all procedures and records appropriate to these principles and their application

In this food safety and quality management system, potential hazards can be identified in processing of safe food, and where and when they are most likely to occur. Then necessary steps must be taken to prevent them from happening or to correct them if they do occur. The hazard analysis steps are fundamental to the HACCP system. To establish a plan that effectively prevents food safety hazards it is crucial that all significant safety hazards and the measures to control them are identified (NSHA 1997).

As reviewed by the National Advisory Committee on Microbiological Criteria for foods (NACMCF 1997), the hazards are defined as a biological, chemical or physical agent that is reasonably likely to cause illness or injury in the absence of its control.

Examples of hazards consist of (Limpus 1997):

- Biological hazards, which include pathogenic microbes (bacteria, viruses, parasites), toxic plants and animals, and products of decomposition (histamine).

- Chemical hazards, which include natural toxins, pesticides, cleaning compounds, veterinary drug residues (antibiotics), heavy metals, and unapproved food and colour additives
- Physical hazard, which include bones, metal fragments, glass, stone that may cut the mouth, break teeth, cause choking, or perforate the alimentary tract.

Determining a critical control point (CCP) plays an important role in a HACCP program. CCP is defined as a step at which control can be applied and is essential to prevent or eliminate a food-safety hazard or reduce it to an acceptable level (NSHA 1997). The CCPs are the points in the process where HACCP control activities will occur. The CCP should be under constant control by humans or by machines and the performance of the control step should be monitored and documented (Lee and Hilderbrand 1992). The determination of a CCP in the HACCP system can be applied with a decision tree that can be a useful tool to identify CCP, but it is not mandatory element of HACCP (NSHA 1997).

The inspection of plants operating under HACCP plans differs from traditional inspection methods of food safety control. Traditional methods evaluate processing practices on the day or days of inspection. The approach of this food safety and quality management program allows regulators to look at what happens in the plant back in time by examining the firm's monitoring and corrective action records (NSHA 1997).

2.4 Prerequisite Program for HACCP

HACCP can not stand alone; it is a part of a larger system of control procedures. HACCP implementation depends on the competence of people who develop and operate it and the prerequisite programmes. Prerequisite programmes may impact on the safety of food; they also are concerned with ensuring that foods are wholesome and suitable for consumption. Formal prerequisite program are increasingly and successfully used to support the implementation of HACCP in food processing (Wallace and William 2001)

Some countries have already identified prerequisites. For example, in North America the US Department of Agriculture Food Safety Inspection Service required not only HACCP, but also Good Manufacturing Practice and Sanitation Standard Operation Procedures (SSOPs) (NSHA 1997). Similarly, the Food and Drug Administration required HACCP and the prerequisite of GMP as a specific requirement for seafood production. As previously mentioned, Malaysia currently requires GMP as a prerequisite before HACCP implementation. Pre-requisite programmes such as GAP (Good Agricultural Practices), GMP and GHP (Good Hygiene Practices) must be working effectively within a commodity system before HACCP is applied. If these pre-requisite programmes are not functioning effectively then the introduction of HACCP will be complicated, resulting in a cumbersome, over-documented system.

2.4.1 Good Manufacturing Practices

A GMP programme may cover (NACMCF, 1997):

1. Establishment Design and Facilities

The structure and location of a processing plant needs to be considered in relation to the nature of operations and risks associated with them. Food

premises should be designed to minimise possibilities of contamination of commodity or product.

- Design and layout should permit maintenance, cleaning and disinfection of the site to minimise airborne contamination.
- All surfaces that come into contact with food should be non toxic, as well as being easy to maintain and clean in order to prevent any additional contamination.
- Suitable facilities should exist for temperature and humidity control, when required.
- Effective measures should exist to prevent access by pests

2. Control of Operation

Effective control measures should be in place to reduce the risk of contamination of the commodity or food supply such that it is safe and fit for purpose:

- Adequate time, temperature or humidity controls
- Food grade packaging
- Potable water supplies
- Maintenance of equipment

3. Maintenance and Sanitation

Procedures and work instructions should exist to demonstrate an adequate level of maintenance of an establishment as well as efficient practices for cleaning, waste management, and pest control. Overall, these operations will support the ongoing control of potential food hazards that may contaminate food.

4. Personnel Hygiene

Measures need to be in place to ensure that food handlers do not contaminate food. This objective can be attained by maintaining an appropriate level of personal cleanliness and following guidelines for personal hygiene.

5. Transportation

The method of transportation should be such that measures are taken to prevent any contamination or deterioration of the commodity. Commodities or product that need to be transported in certain environments should be appropriately controlled, e.g. chilled, frozen, or stored under specific humidity levels. Containers and conveyors used for transporting food need to be maintained in good condition and be easy to clean. Containers used for bulk transfer should be designated and marked specifically for food use only.

6. Training

All food handlers should be trained in personal hygiene, as well as in the specific operation with which they are working, to a level commensurate with their duties. Food handlers should also be supervised by trained supervisors. An ongoing training programme for food handlers is paramount to the success of a Food Safety Management System

7. Product Information and Consumer Awareness

The end product should be accompanied by adequate information to ensure that personnel at the next stage in the food chain will handle, store, process, prepare and display the product safely. Since the consumer may be

responsible for performing the ultimate control measure, the cooking of raw meat or fish, they should have all the relevant information required to carry out this step effectively. All batches of food should be easily identified, by a batch or lot number, to allow traceability of the commodity if required.

In the prerequisite programmes, cleaning and sanitation plays an important role. When it is in place, HACCP can be more effective because it can be concentrated on the hazards associated with the food or processing and not on the processing plant environment. In some situation, it may reduce number of critical control points in HACCP plans (Marriott 1997).

2.5 The International Trade in Food – A Brief Introduction

The present international trade in food has evolved over many centuries. No longer does it simply comprise commercial transactions that take place between buyers and sellers, but instead has become a complex operation that takes place at two levels. At the commercial level buyers and sellers negotiate and agree prices and product specifications, and at the compliance level governments of exporting and importing countries interact to ensure food products meet the statutory requirements of importing countries.

Each element of the operation has become extremely sophisticated. For example, from primitive beginnings, the production of food for both direct consumption and as a raw material for further processing has given rise to the important fields of agricultural, animal and marine sciences. Similarly, the now established science of food technology evolved from man's earliest attempts to process, preserve, store, and transport foods. As a result of these developments

food production is scientifically based and it is possible to transport food over long distance to arrive at its destination in a wholesome condition.

Estimates of the size of world trade in food for human consumption vary considerably, but it is now very large with an annual value of between US\$400 and 500 billion. Products traded include processed and preserved foods of plant, animal and marine origins as well as live animals, fresh fruits and vegetables, grains and beverages (Brown, 1997). An increasing number of countries, including developing countries, are becoming both importers and exporters of food, and the number is expected to increase

Industrialized countries are large food trading nations both in terms of exports and imports. Developed countries are mostly net importers and import more in value than they export. On the other hand, developing countries are in general net exporters, exporting more in value than they import.

The international food export market is of great economic importance, to both developed and developing countries but particularly to developing countries such as Malaysia. Not only does food trading earn hard currency, it also creates and provides work for many people at all links in the export chain.

In order to become successful food exporters, developing countries must produce commodities that consumers in other countries want and which meet the import requirements of those countries in which markets lie. This requires concerted action by producers, shippers and governments to meet basic food legislation requirements.

To implement their laws and regulations many of the most important importing countries established food control agencies whose principal task was, and remains, to ensure that all domestically produced food and food imported complied with the law. Products that did not comply were quite often destroyed