A Systematic Review on Hazard Analysis and Critical Control Points (HACCP) in Southeast Asia Countries

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Abstract

Hazard Analysis and Critical Control Point (HACCP) is a food safety management system which has been recognised as an essential tool in securing food safety. This systematic review aims to assess the current situation and compliance of HACCP system in Southeast Asia as well as the challenges that influence the compliance of the system. Three electronic databases were used for search, which is Science Direct, Scopus and Web of Science. The terms used in the search include food safety, Hazard Analysis Critical Control Point (HACCP), hazard analysis, critical control point and food industry. Fifteen articles met the criteria for inclusion in the review. Five studies were conducted in Thailand, three in Malaysia and Indonesia, and two in the Philippines and Vietnam. This review found that there are certain motives for the application of HACCP, and most of the reviewed studies comply with the HACCP principle accordingly.

Keywords: *Food safety; HACCP; Hazard Analysis Critical Control Point; Food industry.*

Introduction

Foodborne disease and illness have been identified as one of the most widespread public health problems and remains uncontrolled in both developed and developing countries. The increasing of the foodborne disease reflects that the food safety management in the food industries was poor. There are many foodborne hazards can be found at each stage of the food manufacturing process. For the global estimates, the foodborne hazards caused 600 million foodborne disease and 420,000 deaths in 2010[1].

A food safety management system such as Hazard Analysis Critical Control Point (HACCP) should be implemented in combating the increasing of the foodborne disease. The HACCP system can be considered a useful tool for both the food industries and health authorities in preventing the foodborne disease. This system prevents the occurrence of foodborne hazards from production through manufacturing, storage and distribution of a food product in food manufacturing operations. Several reports indicated that the HACCP implementation resulted in improved safety and quality of the food products[2,3].

The success and effectiveness of the system in preventing foodborne disease and reducing food safety risk to an acceptable level depending on the correct application and implementation of the HACCP system[4,5]. These findings also being supported by Panisello and Quantick that cite that the success in implementing and maintaining a HACCP program depends on the commitment, education and training, availability of resources and external pressure in a company[6].

Therefore, efforts must be made to strictly comply with hygiene and safety measures based on the HACCP principle. According to Bas, Ersun, and Kivanc proper food safety practices and pre-requisite food safety programs for HACCP were often not being followed in many food businesses[7]. Thus, this review study focuses on food and beverages industries to determine the current situation of food safety management systems of HACCP focusing in Southeast Asia countries and further study to

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assess the compliance as well as its challenges of these food safety management systems.

Materials and Method

A systematic search strategy performs to discover studies regarding HACCP in the food industry in South East Asia. The databases used for searching are Science Direct, Scopus, and Web of Science. The terms used in the search included Hazard Analysis and Critical Control Point, HACCP, hazard analysis, critical control point, food industry, food business and food and beverages industry. This combination of keywords with the boolean operators "or" and "and" used to narrowing the searching. The search is also carried out by a hand search in Google Scholar and the reference lists of the included studies.

Full-text articles were reviewed and included for analysis based on following eligibility criteria: (1) studies on Hazard Analysis of Critical Control Point (HACCP) including 7 principles, (2) studies must be selected from the food industry in Southeast Asia countries, (3) studies that published in English. Studies were excluded based on following criteria: (1) studies that are not related to the keywords such as studies on food toxicology, food microbiology, food chemistry and food environmental, (2) studies in quality assurance, quality control and quality management system, (3) studies assessing the knowledge, attitude and practices and (4) previous review articles from others.

In assessing the quality of the included studies in this systematic review, the checklist from Strengthening the Reporting of Observational Studies in Epidemiology (Strobe-statement) is used. The data will be extracted from each selected article that meet the eligibility criteria. At the initial review, the extracted data, including the type of study design, the purpose of the study, population, assessing the reliability, and study outcomes. The retrieved data were then being analysed to answer the primary research and sub-questions.

Result and Discussion

Overview of Included Studies: A total of 960 records were identified through electronic databases (n=953) and other sources (n=7). After removing duplicates, 686 titles were screened. Of these articles, 618 were excluded after the title and abstract analysis revealed they did not meet the inclusion criteria outlined in the method. The remaining 68 full-text articles were then screened and assessed for eligibility. Fifty-four articles were excluded. The remaining fifteen articles were found to meet all inclusion criteria and were included in the analysis. The location of the studies had five that conducted in Thailand, three each respectively in Malaysia and Indonesia, and two each in the Philippines and Vietnam. In total, this systematic review examined the findings from fifteen articles assessing the application of HACCP in the food industry, the challenges in the HACCP implementation as well as provide an in-depth exploration of the current application of this food safety management system.

Hazard Analysis and Critical Control Point (HACCP) Implementation: In implementing the HACCP system, the first step is determining the HACCP team. This team will usually make up of people with specific knowledge and expertise regarding the food production process. They will be the one responsible for setting the HACCP plan.

A HACCP team then will start by applying the first principle, which is the hazard analysis. To do this, they will construct a flow chart of the food production flow step by step, starting from primary production until to the point of distribution or consumption. From each of the process steps identified, the HACCP team will assess whether there are any food safety hazards to be a concern[8]. After that then analysis of hazard is conducted. From the analysis, possible hazards likely to happen can be determined.

For example, a study by Damayanti et al. (2017) in the production process of oyster mushroom chips in SME in Indonesia, has started their HACCP with the process of assembling the team, describing their products, identify intended use and constructing the food production flow chart. Then the HACCP team conduct the hazard analysis. The analysis was done at every stage dealing with the production process from the fresh oyster mushrooms until the mushroom chip packaging process. This analysis was done at every step, so the hazard identified could be avoided and controlled.

As for study by Edmunds et al. in poultry trade chain in Vietnam, the flow chart of the poultry trade is developed before the hazard analysis[9]. The flow chart of food processing is prepared before the hazard analysis, and the HACCP team will verify the accuracy of the flow chart. The flow chart then is presented to the experts for critical analysis, thus determining the CCPs. It was done

to assess where the possible process within the poultry trade, which providing high risk of highly pathogenic avian influenza (HPAI)-H5N1 viruses. In contrast to the same study involving poultry which is live bird market in Indonesia, the CCPs are identified from the finding from a survey assessing the poultry workflow, facilities, practices and H5N1 contamination in the market, and also the capacity of the pre-requisite programs (PRP). The findings of the survey and the synthesis of PRP capacity then formed the basis for identification of the CCPs[10].

A study by Thao et al. has identified potential hazards in the cassava production at SME level in Vietnam[11]. From the hazard analysis conducted, the potential hazards recognised at each processing stages of cassava starch processing were classified into three groups which are biological hazards, chemical hazards, and physical hazards. Hazard analysis will provide a basis for determining the CCPs[12]. If this first step is done inappropriately and the control measures are not being identified, the plan will not be effective despite how well it is being followed. Therefore, the HACCP team needs to know possible biological, chemical and physical hazards associated with the processes of evaluation.

After identifying the potential hazard during the hazard analysis, the HACCP team will determine the steps in the production process which are essential to prevent food safety hazard, eliminate food safety hazard or reduce food safety hazards to acceptable levels. The information from the hazard analysis should enable the HACCP team in identifying which steps in the production process are CCPs by using tools such as decision tree[13,14]. Determination of the CCP is crucial as it notifies production the step or procedure that need better treatment to maintain the products' safety and quality[15].

In the application of HACCP in cultured carp in controlling of Opisthorchis has identified four CCPs by the HACCP team[16]. The critical limit and monitoring procedure for each CCP has been established. However, no validation or documentation process is being stated. The implementation of HACCP in cultured carp brings positive contribution as it can control the infection.

From the study conducted by Nazir et al., in palm oil processing, they have identified 20 hazards point in different stages of the crude palm oil process[17]. Besides the 20 hazards point that was pointed out, the corresponding control measure for each of the issue to enhance the quality of crude palm oil also being discussed. However, there is no critical control point to establish. This might be because the hazard that was identified in a process step could be eliminated in the next step. It is also being supported by Wallace and Williams, as they mentioned that the CCP must be realistic, that the number of CCP is not too much to the extent that does not make sense[18]. Number of CCP will affect the food safety system and essential in ensuring the effectiveness of the HACCP system for daily practice.

In the production of canned sardine, Herdiana has identified two CCPs which are the receiving and double seaming process[19]. The control measure and monitoring procedure concerning on what, how, when and who responsible regarding the monitoring procedure also been stated.

In assessing the salmonella reduction in Thailand commercial frozen broiler processing, four CCPs has been established, which is washing, chilling, deboning and packing[20]. From the findings of skin swabs of frozen broiler chicken at each CCP, it was found that three CCPs which are chilling, deboning, and packing were failed to meet the standards of minimal 20% allowed for salmonella positive. Thus, intervention for the corrective action has been established at CCP of chilling and resulting all values were below the 20% critical limit. It shows that the company complies with the HACCP plan as they take action to correct the CCP.

The motives of HACCP implementation: According to the studies done in Malaysia, Thailand, and the Philippines, shows that there are a few motives and factors that influence the HACCP implementation[21-24]. The reasons for adopting HACCP system among food industry due to the customer requirement, to improve operational efficiency, for the expected gain of social legitimacy and company's perception of good practice, for the expected growth of economic competitiveness, quality improvement and sales increase in the both domestic and international market.

The findings are also consistent with a previous study of the food industry in India that identified the improvement in product quality, improving control of production process, meeting the requirements of major customers, and the company's perception of good practice as the motivating factors for HACCP implementation[25]. Besides, some researchers claim

that the main aims of the HACCP system are for the identification, assessment, and the control of foodborne safety hazards [26, 27, 28, 28]

The customer requirement can be defined as the 'true motivator' for the food industries to implement HACCP, especially for the companies that export their food products. This will therefore give the expected gain of export sales. The expectation of new markets and new customers also one of the reasons to initially adopt HACCP. Similar finding from the study by Maldonado-Siman, Bai, Ramírez-Valverde, Gong, & Rodríguez-de Lara, where it was found that the first motivation for Mexican meat enterprises to implement HACCP is for access to new foreign markets[30]. Kingphadung & Choothian did mention that for food products to be export to other countries, it requires food safety certifications, such as HACCP and ISO 22000[31].

The Challenge towards Effective HACCP Implementation and Compliance: In implementing the HACCP system, some companies in the food industry might face common challenges or barrier. The significant challenges include the lack of awareness and understanding to HACCP guidelines, lack of technical expertise, limited sources available regarding HACCP information, lack of employee engagement and budget constraint[32].

Lack of employees who aware and understand the HACCP system were perceived as a significant challenge. Findings from other studies also show the same as most of the employees in the food production companies lack knowledge of the HACCP system[33,34]. Lack of employee commitment and engagement in HACCP implementation is the most concerned as the barrier[23,31]. According to HACCP requirements, companies must develop guidelines for all processes and must control all the productions processes to meet the HACCP requirements. Besides, all employees who operate in those processes must pay attention to these guidelines. The developed guidelines might change the way that employees used to work before or might add more tasks to their jobs, such as recording or reporting data. The overwhelming number of changes and complicated workloads on their job could result in the resistance of employees on the HACCP implementation thus leads to a negative attitude towards the HACCP system. Employees might not be motivated to comply with the HACCP implementation. Without employee engagement, it will be challenging to implement HACCP successfully[5].

Findings found from studies by Gilling et al. also similarly found that the main barriers to the effective HACCP implementation are due to HACCP being considered as problematic, burdensome and unnecessary[35]. Other researchers also noted that HACCP is not implemented correctly was due to time-related constraints and mostly due to a large amount of documentation required[6].

Besides, budget constraints related to the cost of development and operation of the HACCP system also the main possible limitation in adopting HACCP system. According to Yapp and Fairman, the value of the HACCP implementation is the main challenge faced by companies in many countries concerning in terms of investment in structure, equipment and staff training[34]. From the study by Kingphadung and Choothian in agricultural food companies in Thailand, the respondents stated that the implementation of HACCP needs a significant investment which is a challenge towards the HACCP implementation[31].

Most companies need to spend a large amount of money on consultants, equipment, facilities, training, auditing and process improvement to meet the HACCP requirements[24,30]. Some companies might have to adjust their building and facilities suitable for the HACCP implementation. This to ensure all processes can run under control and produce food product regarding HACCP requirement. Similar findings were found in Maldonado-Siman et al. study. Maldonado et al. in their study on the implementation of HACCP in Mexican and Chinese meat industry also found the same as both meat industry concerns related to costs of implementing the HACCP system[30].

According to a study conducted by Ragasa et al. in the Philippines, it was found that only 38% of firms remained certified, and 62% of the initially certified firms abandoned certification[23]. Both certified and de-certified firms cited budget constraints as their most significant challenge in continuation adoption of the HACCP system. The de-certified firm has stated that compliance requirements became stricter. Same as challenges expressed by the respondent in the studies done by Zulkifly et al. as there is a manager that considered the strictness level of HACCP as an obstacle during the HACCP implementation[24].

Conclusion

In conclusion, the application and the challenges that food industries might face during the HACCP implementation could assist companies in creating plans to respond to the challenge for the successful functioning of HACCP.

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