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Original Article

The implementation of a Hazard Analysis and Critical Control Point management system in a peanut butter ice cream plant

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ABSTRACT

To ensure the safety of the peanut butter ice cream manufacture, a Hazard Analysis and Critical Control Point (HACCP) plan has been designed and applied to the production process. Potential biological, chemical, and physical hazards in each manufacturing procedure were identified. Critical control points for the peanut butter ice cream were then determined as the pasteurization and freezing process. The establishment of a monitoring system, corrective actions, verification procedures, and documentation and record keeping were followed to complete the HACCP program. The results of this study indicate that implementing the HACCP system in food industries can effectively enhance food safety and quality while improving the production management.

1. Introduction

Peanut butter ice cream is a food that is made from a mix of dairy products and peanut butter with the addition of sugar, stabilizers, and emulsifiers, and then processed to produce the frozen dessert. Ice cream products are very popular in Taiwan, accounting for a market share of approximately 1400 million New Taiwan Dollars, which is about 17,000 tons of ice cream according to the economic statistics of 2013 [1]. Likewise, peanut products are well liked and widely consumed by Taiwanese people of all ages, making peanut butter ice cream a favorable choice among the many ice cream flavors. However, peanut butter is easily subjected to aflatoxin

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contamination due to the hot and humid climate of Taiwan, which may pose a severe threat towards food safety [2]. In addition, the microbiological quality of ice cream can be low as its many nutrients and neutral pH value makes it a good growth medium for microbes [3]. Therefore, the prevention of microbial contamination is crucial, and a tailored food safety control system should be established to ensure the safety of the peanut butter ice cream production.

Hazard Analysis and Critical Control Point (HACCP) is a scientific and systematic approach applied in the food industry for the identification and the control of specific hazards. The HACCP program covers the input of the materials, production process, final products, facilities, and personnel at the critical control points (CCPs). It consists of two major components: hazard analysis and the control measure of the critical limit. Hazard analysis is the process of identifying and evaluating the potential hazard factors that may negatively affect food safety, while the control measure is to prevent or eliminate the hazards to a minimized and acceptable level [4]. The HACCP system has been widely adopted by countries all over the world as well as international organizations, including the World Health Organization and the Food and Agriculture Organization, and is currently a world-recognized preventive management system to maintain food hygiene.

In Taiwan, HACCP is defined as the *Food Safety Control System* in the regulations of the Department of Health (now upgraded to the Ministry of Health and Welfare) [5]. It is an extended food safety supervision that is based on the present standard operating procedures, Good Manufacturing Practice, and Good Hygiene Practice [6]. Although the HACCP system has been proven to be effective in controlling and preventing food hazards, it is still a voluntary procedure for most food industries in Taiwan. To expand the application of HACCP in Taiwanese food industry, the government has been promoting this control system stage by stage, from encouraging spontaneous employment to mandatory implementation in certain food sectors [7]. With the occurrence of many food safety issues in recent years, HACCP could be a possible alternative to avoid these problems and ensure food safety.

Various studies have been conducted to assess the ice cream production after the application of a HACCP program, and this has proven to have positive effects on both the microbiological quality and the overall quality of the final product [8–10]. In this case study, information on the peanut butter ice cream production was collected and evaluated, and a HACCP plan (Table 1) was implemented to this production process. The quality and safety of the peanut butter ice cream product can be effectively guaranteed through this HACCP implementation (Table 2).

2. Materials and methods

2.1. Study object

The entire production process of peanut butter ice cream was evaluated including the plant layout, facility structure, technical standards, cleansing method, staff assignment, safety control, storage conditions, and distribution (Fig. 1). The potential biological, chemical, and physical hazards that may exist in the peanut butter ice cream production process were identified and CCPs were selected.

2.2. Methods

Based on the 2008 revised form of the *Food Safety Control System* of the Department of Health, Executive Yuan, and the *HACCP and guidelines for its application* of the United Nations Codex Alimentarius Commission, the overall technical process of peanut butter ice cream production was drawn and a hazard analysis was performed. CCPs were subsequently identified and selected. Critical limits, as well as a monitoring system, corrective actions, verifications, and documentation and records were then established according to government regulations and industry standards. The decision tree method, a visual and easy-to-understand analysis, was applied to determine the CCPs.

3. Results and discussion

The flow diagram of the peanut butter ice cream production is summarized in Fig. 2, including the receiving of raw material, weighing and blending, pasteurization, homogenization, cooling and ageing, freezing (followed by peanut butter addition), packaging, hardening, and storage and distribution.

3.1. Hazard analysis and prevention measures establishment

Hazard analysis was conducted at every technical procedure starting from the receipt of materials to the delivery of the final product. All biological, chemical, and physical agents with the potential to cause adverse health effect were identified and evaluated. The significance of each hazard factor will be determined by the severity of the risk.

3.1.1. Receiving of raw material

As a major ingredient, milk and milk products provide ice cream with milk fat and nonfat solids, which contributes to its unique mouth feel and rich flavor. The fresh cream from milk offers a fine combination of lipids that produces the smooth texture and the melting properties of the ice cream [11]. All dairy products must meet the requirement of the *Ministry of Health and Welfare: Sanitation Standard for Milk and Milk Products*, and each one should also conform to the *Chinese National Standards* according to its distinctive type. Egg yolk normally serves as an emulsifier in ice cream products. It is a source of lecithin, which provides emulsifying properties to develop the creamy characteristic desired in ice cream [12]. As regulated by the Taiwanese government, egg products are required to meet the conditions set by the *Ministry of Health and Welfare: Sanitation Standard for Eggs and Egg Products*. In addition, suppliers are strongly encouraged to submit self-inspection reports to ensure food safety, especially in regards to *Salmonella* contamination. Being the main flavoring of the peanut butter ice cream, peanut butter is subjected to the law of the *Ministry of Health and Welfare: Sanitation Standard for the Tolerance of Mycotoxins in Foods* to regulate the amount of aflatoxin (no more than 15 ppb) in peanut products.