



## HACCP – The difficulty with Hazard Analysis



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### ARTICLE INFO

#### Article history:

Received 15 October 2012

Received in revised form

25 May 2013

Accepted 6 July 2013

#### Keywords:

Hazard analysis

HACCP

HACCP principle application

Food safety

Risk assessment

HACCP effectiveness

### ABSTRACT

HACCP is a key element of modern food safety management practice such that design, implementation, control and management of HACCP systems are crucial to the production of safe food products. Whilst it is widely accepted that food companies should apply HACCP, understanding of the factors impacting successful HACCP application is limited and this knowledge is important to the delivery of systems that will control all relevant food safety hazards. HACCP principle 1, *Conduct a Hazard Analysis*, forms a central pillar of any HACCP plan since hazards need to be identified, analysed and understood before effective control measures can be specified. However limited guidance is available to HACCP teams on exactly how to approach the application of this principle. This paper discusses an investigation into the application of HACCP principle 1 by HACCP teams operating within manufacturing sites of a multinational food company. Using a combination of HACCP knowledge testing and HACCP plan assessment, the study identified weaknesses in knowledge of significant hazard identification and errors in the hazard analysis process, including errors in application of structured risk evaluation methods. Findings suggest that this is an area of difficulty for HACCP teams and that further detailed guidance in the application of this HACCP principle is urgently needed.

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### 1. Introduction

Food safety management depends on the ‘building blocks’ of safe product design, prerequisite programmes and HACCP all being applied fully and correctly (Wallace, Powell & Holyoak, 2005a). Focussing on the HACCP building block, achievement of effectiveness depends on the design, implementation, control and management of the HACCP system. This framework for effective HACCP should achieve safe food production when accompanied by other building blocks within the food operation, however there is a need to understand the factors impacting successful HACCP application such that food companies can design, implement and manage systems that will control all relevant food safety hazards, i.e. effective HACCP (Fig. 1).

*Abbreviations:* Codex, Joint FAO/WHO Food Standards Programme, Codex Alimentarius Commission Committee on Food Hygiene; HACCP, the hazard analysis and critical control point system of food safety management; NACMCF, The United States National Advisory Committee on Microbiological Specifications for Foods.

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Recent work (Yiannis, 2009; Griffith, Livesey & Clayton, 2010a, 2010b; Powell, Jacob & Chapman, 2011) has focussed on the area of food safety culture, defined by Griffith et al. (2010a) as ‘the aggregation of the prevailing, relatively constant, learned, shared attitudes, values and beliefs contributing to the hygiene behaviours used within a particular food handling environment’. It is clearly vitally important for food safety effectiveness that an appropriate blend of shared attitudes, values and beliefs is in place within food businesses to ensure the correct behaviours in line with planned systems and procedures. In HACCP terms this means that the control procedures specified by a valid HACCP plan will only work in practice where that appropriate blend of attitudes, values and beliefs exists and, therefore, The HACCP Effectiveness Framework (Fig. 1) will only operate effectively within a strong business food safety culture. However, it is still essential that we continue to investigate the effectiveness of the HACCP system itself, since this plays a crucial role in defining how food safety hazards need to be controlled in order to protect public health. Even with a good food safety culture we are at risk of harming the consumer if there are flaws in our HACCP plans due to technical errors in their construction.

To achieve effective HACCP, successful application of the HACCP Principles (Codex, 2009) is crucial at the HACCP Design stage.

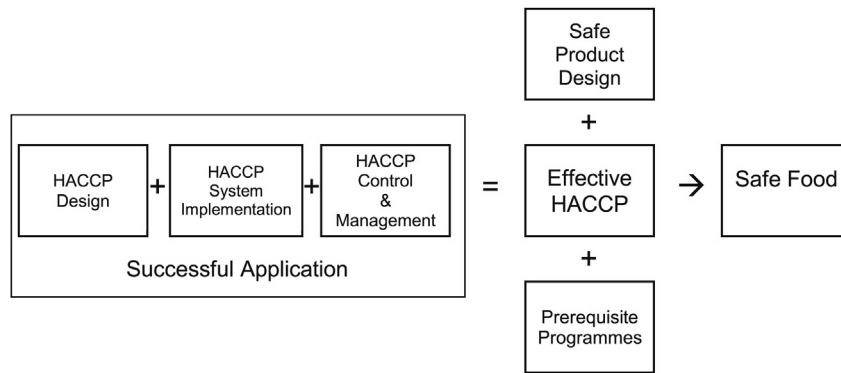


Fig. 1. HACCP effectiveness framework.

Whilst all principles are important, principle 1, *Conduct a Hazard Analysis* forms a central pillar of any HACCP plan since hazards need to be identified, analysed and understood before effective control measures can be specified. However limited guidance is available to HACCP teams on exactly how to approach the application of this principle. Codex (2009) lists some brief points to consider when performing hazard analysis (Table 1) and NACMCF (1997) also lists a series of questions to help the HACCP team discuss different hazard issues, although many of these latter questions are directed towards prerequisite programme issues rather than hazards.

Current thinking is that the HACCP team should consider each raw material and process activity in turn and list any potential hazards that might occur, then carry out an analysis to identify the significant hazards before identifying suitable control measures (Mortimore & Wallace, 2013; Wallace, Sperber & Mortimore, 2011). Closer investigation of the key term definitions from internationally accepted HACCP Guidelines (Codex, 2009; NACMCF, 1997) is helpful in understanding this hazard analysis process further:

**Hazard analysis:** The process of collecting and evaluating information on hazards and conditions leading to their presence to decide which are significant for food safety and therefore should be addressed in the HACCP Plan (Codex, 2009).

**Hazard:** a biological, chemical or physical agent in, or condition of, food with the potential to cause an adverse health effect (Codex, 2009).

**Table 1**  
Codex Guidance on Application of HACCP Principle 1.

List all potential hazards associated with each step, conduct a hazard analysis, and consider any measures to control identified hazards
The HACCP team should list all of the hazards that may be reasonably expected to occur at each step according to the scope from primary production, processing, manufacture, and distribution until the point of consumption. The HACCP team should next conduct a hazard analysis to identify for the HACCP plan which hazards are of such a nature that their elimination or reduction to acceptable levels is essential to the production of a safe food. In conducting the hazard analysis, wherever possible the following should be included:
<ul style="list-style-type: none"> <li>- the likely occurrence of hazards and severity of their adverse health effects;</li> <li>- the qualitative and/or quantitative evaluation of the presence of hazards;</li> <li>- survival or multiplication of microorganisms of concern;</li> <li>- production or persistence in foods of toxins, chemicals or physical agents; and,</li> <li>- conditions leading to the above.</li> </ul>
Consideration should be given to what control measures, if any exist, can be applied for each hazard.
More than one control measure may be required to control a specific hazard(s) and more than one hazard may be controlled by a specified control measure

Source: Codex, 2009.

**Hazard:** a biological, chemical, or physical agent that is reasonably likely to cause illness or injury in the absence of its control (NACMCF, 1997).

This latter hazard definition provides a reminder of the need to evaluate risk to consumer health, should no control be in place. Hazard analysis, therefore, is a key element of HACCP that, alongside the identification of suitable control measures, will determine the strength of the resulting HACCP Plan. The Hazard Analysis needs to be accurate and specific; if it is too brief or general then the following steps in the HACCP study will be more difficult and the HACCP Plan is likely to be weak (Wallace, Sperber & Mortimore, 2011).

### 1.1. Determination of hazard significance

As shown in Table 1, Codex (2009) requires ‘control of hazards that are of such a nature that their elimination or reduction to acceptable levels is essential to the production of a safe food’ and states that the process of hazard analysis is intended to ‘identify those hazards that are significant for food safety and therefore should be addressed in the HACCP plan’. Although the term significant hazard is not defined by Codex, the International Life Sciences Institute (ILSI, 1999) has put these two phrases together to form the definition:

**Significant Hazard:** Hazards that are of such a nature that their elimination or reduction to an acceptable level is essential to the production of safe foods (ILSI, 1999).

To identify the significant hazards it is necessary to consider the likelihood of occurrence of the hazard in the type of operation being studied as well as the severity of the potential adverse effect. A significant hazard, therefore, is one that is both likely to occur and cause harm to the consumer and identification of significant hazards needs to be based on sound data.

When considering how to identify significant hazards, Sperber (2001) reported that this was generally based on past experience since ‘most of the hazards you will need to consider are already known and the relevance, or significance, to your process is also known’. In line with this thinking, many HACCP teams within food manufacturing companies assess significance of hazards using judgement and experience but structured ‘risk evaluation’ methods, where different degrees of likelihood and severity are weighted, are increasingly being used to help with the significance decision. Structured risk evaluation methods often involve significance assessment tables or matrices which aim to consider the degree of likelihood and the severity of effect by rating these as, for

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