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Application of Quality Function Deployment for the development of an organic product

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ABSTRACT

The application of the Quality Function Deployment (QFD) method to develop food products has been reported in a number of studies. Nevertheless, QFD was originally designed for other industrial sectors, and as such, certain adjustments are necessary for an effective application in the food sector. In this context, this study aims at demonstrating an application of QFD in the development of an organic product. There has been growing global demand for this type of product in recent years. This type of QFD application is not empirically consolidated in the literature. Thus, this study might be considered a pilot work. A QFD conceptual model consisting of four matrices was constructed to develop an organic fruit jelly. The main adaptation is in the first matrix, which includes the key players in the supply chain. As food's ingredients have natural variations in composition, the interactions among the ingredients are to be considered. In addition, the influence of the production processes on the product's functional properties and the effects of the supply chain on the ingredients ensure that this type of product development has different variables compared to other QFD applications for non-food products. Therefore, the conceptual model used in this study may serve in the development of other food products. This study asserts that the element of socio-environmental responsibility is essential for developing an organic product because this dimension comprised one-third of the relative weight of the planned quality.

Introduction

In the 1960s, companies in Japan exhibited strong growth, particularly in the automotive sector, with constant changes to existing vehicle models and new product launches (Akao, 1990, 1996; Carnevalli, Sassi, & Cauchick Miguel, 2004). This growth generated the need for a method that would assure product quality in all phases of the new product development process. Studies performed in Japan to meet this need resulted in a method called Quality Function Deployment – QFD (Akao, 1996). The purpose of QFD is to translate the quality requirements from customers into the attributes of a product; however, it can also be used to develop services (Carnevalli & Cauchick Miguel, 2008). The application of QFD improves product reliability, reduces design time (Devadasan, Kathiravan, & Thirunavukkarasu, 2006), and increases customer satisfaction (Carnevalli, Cauchick Miguel, & Calarge, 2010; Lager, 2005).

Seeing the benefits of its application, QFD was adopted by several other countries and was introduced in the USA and Europe in the 1980s. Although QFD has been used in the food industry since 1987, the published examples are relatively limited (Benner, Linnemann, Jongen, & Folstar, 2003; Hofmeister, 1991). In Brazil, the method was only just introduced in the 1990s (Carnevalli et al., 2004). At that time, the method was introduced in a food and packaging company (Sadia S.A.), and there are reports of QFD applications in the industrial sector in Brazil since 1995 (Cheng, 2003).

It is worth mentioning that the production of and market for organic foods have expanded internationally and in Brazil since the 1990s (Guivant, 2003). The global demand for organic food has risen because people are more aware of the health impacts of chemical residues in foods (Arbos, de Freitas, Stertz, & Carvalho, 2010). Similarly, other researchers (e.g., Lobley, Butler, & Reed, 2009; Louden & Macrae, 2010; Maxey, 2006; Retamales, 2011; Trauger, 2007) argue that the demand for organic foods is growing fast. Moreover, Demiryurek (2010) highlights that the growing consumer demand for organic foods has led to the development of international trade in organic agricultural products.

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Organic food production is aimed at producing ecologically sustainable, economically viable, and socially equitable food capable of integrating mankind into the environment (dos Santos & Monteiro, 2004). Moreover, the previous authors argue that the production of organic food has grown in both land areas under cultivation and in the number of producers and consumer markets, even though organic food represents a small portion of agriculture. The growth of organic agriculture is observed because conventional agriculture is based on the intensive use of chemicals. Consumers regard the conventional production system as a possible risk to their health and the environment and seek contamination-free products (dos Santos & Monteiro, 2004). Organic agriculture is a production system that aims at achieving a better quality of life for those who produce and consume food. Considering the demand and market for this type of product, further growth is projected in this market segment (dos Santos & Monteiro, 2004).

Considering the increased demand for organic foods and the variety of food choices, producers seek to differentiate their products to gain consumers. The QFD method fulfils this purpose because it captures the voice of customers (VoC) and transforms it into the quality characteristics and attributes of the product. Although there have been publications on this subject in the food industry, outlets concerning the use of QFD in the development of organic food, which is the focus of this paper, are scarce.

This work is aimed at demonstrating a QFD application in the development of an organic product, that is, an organic fruit jelly. The following sections present the concept of QFD and its use in food product development. The subsequent section describes the research methods and procedures used to conduct this work. The following section presents a proposal for the application of QFD for the development of organic products. Finally, the conclusions of this work are drawn.

Related literature regarding Quality Function Deployment

Cheng and de Melo Filho (2007) define QFD as a way to systematically communicate information related to the level of quality and explain the work related to achieving quality, thereby aiming to reach the level of quality during product development. To achieve this, QFD uses matrices to deploy customer demanded quality throughout the product development process. There are two theoretical lines in the application of QFD. The first line, proposed by Akao (1990), is as follows: there are a number of matrices with an emphasis on quality, technology, reliability and cost. The other line is the four stages model proposed by Hauser and Clausing (1988), which is a simplified model in which four matrices are drawn, one for each stage of product development: the house of quality, component planning, the planning process and production planning. The set of matrices should be in place regardless of the theoretical line. This set is called the QFD conceptual model. It can be defined as a set of deployment tables and matrices of a given product development, in which the matrices are established considering cause and effect relationships (Cheng & de Melo Filho, 2007).

The use of QFD has benefits and drawbacks. There are tangible benefits, such as improved reliability, reduction in the number of changes during product development, design time and costs, and complaints, as well as increased revenues (Carnevalli & Cauchick Miguel, 2008). The intangible benefits are a flexible method, with communication improvement, assistance in decision-making and priority setting, and increased company knowledge preservation and customer satisfaction (Carnevalli & Cauchick Miguel, 2008).

There are difficulties in using QFD, including interpreting customer desires, defining the relationships between demanded quality and quality characteristics, developing teamwork and general lack of knowledge of how to use the method (Carnevalli & Cauchick Miguel, 2008). Such difficulties have decreased the use of QFD. The authors of this study have proposed a way to reduce these difficulties. The difficulties and the proposal to reduce them are complemented by the studies of Benner, Geerts, et al. (2003) and Benner, Linnemann, et al. (2003), all of which are specifically focused on the development of food products.

QFD in the development of food products

The QFD method can be used in the development of different types of products (Benner, Linnemann, et al., 2003). Cauchick Miguel (2005) conducted a multiple-case study in seven companies operating in Brazil to identify the best practices in the development of products using QFD. It was observed that the application of QFD in the food sector is one of the method's best in the country.

Benner, Linnemann, et al. (2003) discuss whether QFD can be fully applied in the development of food products, taking into account that the method was developed for other industrial sectors. Publications on QFD in the development of food products typically present general information, and the focus is on the first matrix and related to quality (demanded quality *versus* quality characteristics). The previous authors add that, after a thorough analysis of the published examples, it is clear that the information is not as useful as it first seemed. The applications are quite limited, especially with regard to the four phases conceptual model; some publications show the four stages approach, but a large majority do not go beyond the first matrix.

The QFD is better suited to the improvement of food products that already exist than to developing new products (Benner, Linnemann, et al., 2003). One of the major disadvantages of the method is the difficulty in using the four stages model for the improvement of food products. This disadvantage occurs because of the complexity of food products, the many interactions between the ingredients and the influence of the productive processes on the product's functional properties. It is difficult to specify the product requirement values (Benner, Linnemann, et al., 2003). There is a natural variation in the composition of food ingredients generating a higher standard deviation in comparison to the value obtained in other industrial sectors.

Benner, Linnemann, et al. (2003) claim that the matrices are very useful in visualizing the data and information necessary to improve and develop a new product. Even when applying QFD as presented by other researchers with expert experience, the method may not be applied in the food sector without changes. The final quality of food products depends not only on the quality of ingredients but also on the processes that are applied by those involved in the production chain. Benner, Linnemann, et al. (2003) suggest some simplifications of the product in terms of its characteristics and interactions to retain manageable matrices. These simplifications must rely on research and development (R&D) knowledge and those involved throughout the entire production chain. Another adjustment to the QFD method to make it applicable to food products is the replacement of objective values with intervals-objectives because ingredients are often physiologically active and subject to change.

Some proposals for modifying the QFD to apply it to the development of food products have been made. Hofmeister (1991) proposed that the 'QFD Food Industry Roadmap', in which two alternative paths are defined from the voice of customer, be used throughout the new product development process in the development of packaging or food. Bech, Engelund, Juhl, Kristensen, and Poulsen (1994) divide the engineering features ('hows') into techniques and sense. Holmen and Kristensen (1996) divided the attributes of customer needs into those of the intermediary user and