UNIWERSYTET EKONOMICZNY W POZNANIU

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Determinants of the effectiveness of hazard analysis in the manufacturing of food packaging

Summary of doctoral dissertation

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Poznań 2021

1. Justification for the selection of topic

A vast majority, i.e. as much as 95%, of products manufactured by the global economy is placed on the market in packaging (Patorska & Paca, 2017). Packaging has many different functions and is often defined by the said functions. It may be made of different raw materials and is subject to constant innovation. The value of the global packaging market grows by several percent every year. The most numerous group of packaging is the packaging for food products (Wasiak, 2019). Food packaging is subject to special legal regulations given its impact on the safety and quality of food, and, hence, human health and life.

Packaging permitted for food contact should be analysed as an independent product placed on the market and also as a product inherently related to food (Szymańska, Żbikowska & Marciniak-Łukasiak, 2019). The aim of the use of packaging is to protect food from factors which may cause its quality to deteriorate, such as, in particular light, oxygen, chemical contamination, the presence of microbes and mechanical damage. Packaging must guarantee that food is safe for health and must ensure that consumer health is protected (Czerwińska, 2018).

The manufacturers of packaging materials and unit packs as participants in the food chain must be aware of the impact the said materials have on the safety of food packed or consumed therein. The food chain is described as a sequence of stages and processes that take place in the production, processing, distribution, warehousing and handling of food, including the participants therein, from primary production to consumption . (Litwińczuk A., Zięba, Brodziak & Litwińczuk Z., 2016). The obligation to ensure safety rests, first and foremost, with the manufacturer or the entity placing the product on the market. The seller's obligation, on the other hand, is to cooperate with the manufacturer and the relevant authorities in order to eliminate hazardous products from the market and to do this with due diligence (Lisińska-Kuśnierz & Ucherek, 2006).

Hazard analysis is one of the crucial elements in the development of the food safety system for packaging manufacturers. It is the process of collecting and assessing information on hazards and on conditions conducive to them originating, which is aimed at determining which of these hazards are relevant for food safety (Nawirska-Olszańska, 2012). Hazard analysis should take into consideration biological, chemical and physical hazards (Wallace,

Sperber & Mortimore, 2011; Zalewski & Skawińska, 2016), and also defects affecting the quality of packaging and packaging materials. In the case of hazard analysis, the type of material of which the packaging is made also matters. When classifying the packaging on the basis of this criterion, packaging made of paper and cardboard, plastics, glass and metal should be distinguished and this division has been reflected in the dissertation, in the context of hazard and defect analysis (Lisińska-Kuśnierz, 2005; Emblem & Emblem, 2014).

The effectiveness may be understood as the extent in which the projects planned are completed (Zięba, 2010; Bukłaha, 2012). It is assumed in the dissertation that in order to be effective, hazard analysis must be:

- comprehensive, i.e. comprise all elements and take into consideration all issues related to the packaging safety and quality,
- periodically verified, in particular, in terms of it being up-to-date and adequate,
- effectively communicated to internal and external stakeholders.

Furthermore, enterprises must be aware of the necessity to make changes to their approach to hazard analysis and its continuous improvement resulting from new legal requirements, scientific opinions, changes to research methodology and analytical progress which make it possible to set new limits to detecting contamination. In order to be able to keep the hazard analysis up to date, the quality of management must increase constantly since the improvement is a never-ending process that requires commitment, competence, the will to act and determination; and constant improvement is the essence of a modern approach to the management of quality and organisation(Skrzypek, 2019; Wawak, 2013).

2. Research problem, objective of the dissertation and research hypotheses

There is no research in the literature which would cover in a comprehensive and exhaustive fashion the issue of how hazard analysis is effective in the manufacturing of food packaging. Hence, the main reason for discussing this topic is the author's conviction that there are shortages in the comprehensive approach to the effectiveness of hazard analysis as regards its determinants.

The main objective of the dissertation is to specify the determinants of the hazard analysis effectiveness for enterprises manufacturing food packaging.

Specific objectives of the thesis focused on:

- identifying physical, chemical and biological hazards and quality defects affecting the safety and quality of the packaging manufactured,
- evaluating the significance of hazards for the enterprises analysed,
- identifying methods for evaluating risks related to hazards,
- evaluating the hazard analysis effectiveness in the enterprises analysed,
- identifying and evaluating the effectiveness of methods for verifying whether hazard analysis is up to date,
- identifying and evaluating the effectiveness of methods for notifying internal and external stakeholders of hazards,
- specifying guidelines used to improve the hazard analysis effectiveness.

The dissertation puts forward the following four research hypotheses:

H1: Hazard analysis in enterprises under evaluation does not cover all typical biological, chemical and physical hazards or quality defects resulting from the specific nature of the process of packaging production.

H2: The most important actions that verify the hazard analysis are audits and laboratory test of the product.

H3: Audits of the other party are the tool used for improving communication with customers and the hazard analysis as such.

H4: Improving hazard analysis is essential to ensuring its continuous effectiveness.

3. Research methods and dissertation structure

The thesis is a theoretical and empirical one. Preparation of empirical tests necessitated a review of the research literature. In order to ensure comprehensive and reliable research, numerous meetings were held with persons in charge of quality and employees of accredited laboratories. Afterwards, a survey was developed with an aid of the Delphi method to be used as a tool to obtain information for empirical tests. Experts invited to share their expertise thereon included scientists, employees of accredited laboratories, employees of certification units – auditors of BRC GS Packaging Materials, as well as persons managing quality and production in enterprises manufacturing packaging for food.

Research was conducted between 2018 and 2020. Participants therein were enterprises certified for compliance with the BRC GS Packaging Materials standard, with their registered office in Poland.

The thesis consists of four chapters whose contents have made it possible to achieve research objectives and to verify hypotheses.

The most typical approaches to the definition and classification of packaging, including food packaging, and basic packaging materials are presented in chapter one. The basic requirements of BRC GS Packaging Materials as the most common standard guaranteeing the quality and safety in the packaging industry are also presented.

Chapter two focuses on physical, biological and chemical hazards, as well as on the quality defects as components of hazard analysis which, in turn, should form a vital element of hazard analysis in the industry of food packaging manufacturers. In this chapter, hazards and quality defects related to the manufacturing of printed packaging are also discussed, with print being treated as a significant source of hazards and defects (Jakucewicz, 2001).

Chapter three is devoted to the hazard analysis effectiveness and describes methods used for evaluating hazards and tools used for verifying whether hazard analysis is up to date and adequate and for communicating information on hazards to internal and external stakeholders.

The tests results obtained are discussed in chapter four. Factors determining the effectiveness of hazard analysis are discussed, test results are summarized, and conclusions and recommendations for enterprises as regards the hazard analysis improvement are specified.

Conclusions pertaining to the objectives and research hypotheses are disclosed in the PhD dissertation summary.

4. Test results and final conclusions

According to the author, the objectives have been achieved and the results of tests have made it possible to verify research hypotheses. The enterprises analysed, despite being subject to regular evaluation by independent, impartial and external units during certification, recognise that they need to make improvements in the area of hazard analysis. The results obtained have shown that entities are aware of the necessity to revise chemical, biological

and physical hazards and quality defects. Tests have also proven that enterprises should review the analysis in the area of the hazards related, in particular, to raw materials and stages of warehousing or transport. Raw materials are an issue which will necessitate additional attention in the nearest future. Changes related to the fact that more recycled raw materials or biodegradable materials are introduced to the manufacturing processes will force changes, in particular, in the lists of suppliers or in the scope or frequency of laboratory tests.

On the basis of the research conducted, the following conclusions and recommendations have been formulated for the manufacturers of food packaging, which will contribute to an increase in the hazard analysis effectiveness:

1. Manufacture of safe packaging for food is one of the guarantees of food safety.
2. Raw materials of which packaging is made determine the hazards and quality defects identified.
3. Identification of physical, chemical and biological hazards necessitates verification and changes to be introduced. There are areas in which not all of the respondents have identified hazards. Enterprises should review the analysis in the area of hazards related, in particular, to raw materials, warehousing or transport of finished products to customers.
4. Estimation of the significance of hazards and defects should be reviewed.
5. Manufacturers of the packaging for direct contact with food recognise physical, chemical and biological hazards as more relevant, unlike manufacturers of packaging for indirect contact with food.
6. Enterprises engaged in printing evaluate chemical hazards as considerably more relevant (except for heavy metals for which the level of relevance is similar for all enterprises).
7. The catalogue of quality defects necessitates a review; manufacturers of packaging should furthermore verify the relevance of quality defects. This should be done in particular by the manufacturers of packaging in charge of printing.
8. The basic actions which verify hazard analysis are audits performed by the first and third party, laboratory tests of the finished product and swab tests (manufacturing surfaces and workers' hands).

9. When estimating the relevance of hazards, enterprises take into consideration the probability of hazards and their impact on the safety, as well as the traceability of hazards. However, the last determinant is not applied by one fifth of enterprises and this should change. The ease of detecting a potential hazard is extremely important when determining the tools for monitoring potential hazards.
10. Determining Control Points (CP) and Critical Control Points (CCP) is the result of hazard estimate. The number of points depends on many factors such as the type of raw materials and of the packaging manufactured, the complexity of the manufacturing process, the condition of the infrastructure and the awareness of workers. Enterprises which have set 10 and more Control Points and Critical Control Points should, however, review applicability thereof again.
11. Notifying the service providers of the requirements guaranteeing that hazards are eliminated when evaluating packaging manufacturers is the area which has been ranked by enterprises as the least relevant and hence, it is a potential element to be improved in the system of communication, and thus, the system of quality and safety.
12. Training for all employees is a basic tool to communicate information on hazards within the organisation. According to test results, there are companies which do not use training for this purpose and this should change. The fundamental requirement of BRC Global Standard Packaging Materials is to provide training and its main objective should be to build the employee awareness, in particular, in this area.
13. Nearly half of the enterprises do not mention the declaration of conformity as a tool for communicating information on hazards to their customers. This should be a basic tool for communicating with this group of external stakeholders, in particular, given that it is a legal requirement to issue a declaration of conformity as such.
14. The tests have confirmed that audits play a crucial role in developing the safety system in enterprises manufacturing packaging. In addition to the fact that audits are aimed at verifying the hazard analysis conducted, they are also an important tool used for communicating information on hazards to employees, suppliers and customers.
15. Manufacturers of packaging for food evaluate hazard analysis as effective while at the same time they understand the need to improve it. Only several percent of companies are of the opinion that this area of activity in the company does not require any

improvement. Both physical, biological and chemical hazards and quality defects and methods for estimating hazards have been specified as areas for improvement.

16. The largest group, i.e. more than half of enterprises showed that they are aware that hazard analysis in the area of chemical hazards is imperfect. Potential chemical hazards are a complicated issue that necessitates regular monitoring of legal requirements and recommendations published by national, European and international institutions. Enterprises must therefore analyse, on a regular basis, legal requirements and adjust the scope and frequency of laboratory tests to the current legal situation and the requirements of target markets.
17. Customer audits affect the effectiveness of hazard analysis; enterprises should therefore be willing to cooperate with customers and treat audit as information exchange and an opportunity for improvement.
18. Enterprises are aware of the difficulties related to the development of hazard analysis, only one third of companies have developed the hazard analysis independently, i.e. on the basis of expertise and experience of their internal teams for hazard analysis and risk assessment; other companies have done it in cooperation with an external consultant. This is evidence that those in charge of quality management are quite receptive to new ideas and that top management is so committed that they are willing to offer financial support.

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