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Options for Prevention of Product Cross-Contamination in Logistic Processes

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Abstract:- Over the past few years there have been frequent cases of cross-contamination within the logistics supply chains. This paper examines the options for preventing cross-contamination by the application of an integrated product quality and safety system. An analysis of the factors contributing to the prevention or minimisation of the risk of cross-contamination is presented. The application of the method allows assessment of the risk of cross-contamination by identifying the probability of each hazard, its severity and the likelihood of detecting it before the product reaches the consumer. It has been concluded that despite the numerous risks of cross-contamination in the logistics chain, the introduction of a quality management system has the potential to minimise this risk.

Keywords:- *Logistical Processes, Cross-Contamination.*

I. INTRODUCTION

Over the past few years the cases of product withdrawals and recalls from the retail chains and the end users have become more frequent as a result of detected cross-contamination [1, 2, 3, 4, 5], the highest risk being the one related to cross-contamination with allergens [6, 7]. This implies the need to seek further means for prevention, reduction or elimination of the risks of cross-contamination in the logistics chain. The purpose of the introduction of integrated management systems is to control the risks associated with food safety and quality by helping identify and manage them through the introduction of adequate control during each step of the processes that are part of the food chain.

There are two ways to seek prevention of cross-contamination in the logistics chain. One of them is to ensure the introduction of a procedure for controlling the more accurate product label declaration of ingredients [8, 9] that could be present as a result of cross-contamination in the logistics chain, so that those suffering from allergies could avoid the relevant food products [10, 11]. The second way is through the application of a product quality and safety management system to exercise effective control [12, 13] in order to ensure that when the occurrence of a specific contaminant due to negligence can be identified in case of cross-contamination, its amount in the product is not in levels that would create a risk for people suffering from allergies and that the product will be safe for human consumption [14]. These two methods can be fulfilled by applying an integrated management system and by using it for effective management of the processes [15, 16].

The purpose of this study is to ensure the reduction, prevention or elimination of the food safety risks as a means to protect consumers by applying a cross-contamination risk management model in logistics organisations.

II. METHODS

The 11-step model (presented in figure 1) was applied in this study for identification, prevention and reduction of all significant risks of cross-contamination in logistics organisations. The model was used as part of the quality and safety management system in the companies where it was applied. The analysis based on the model indicated on figure 1 was applied in 5 logistics organisations. Significant risks were defined as the risks that could adversely impact the systems and are very likely to result in an overall failure of the system. The application of the model took place based on the following key stages:

- Formation of a team of experts for introduction of the model;
- Analysing the existing risk management system in the studied logistical processes;
- Dividing the system into subprocesses, constituents and stages of the processes related to unpacking, packaging, wrapping or repackaging of the products;
- Identification of the primary and secondary functions of each process and identification of the possible risks; Application of the 11-step model;
- Second analysis of each of the indicated stages of the model;
- Identification of the planned measures in the model for compensating and preventing the risks.

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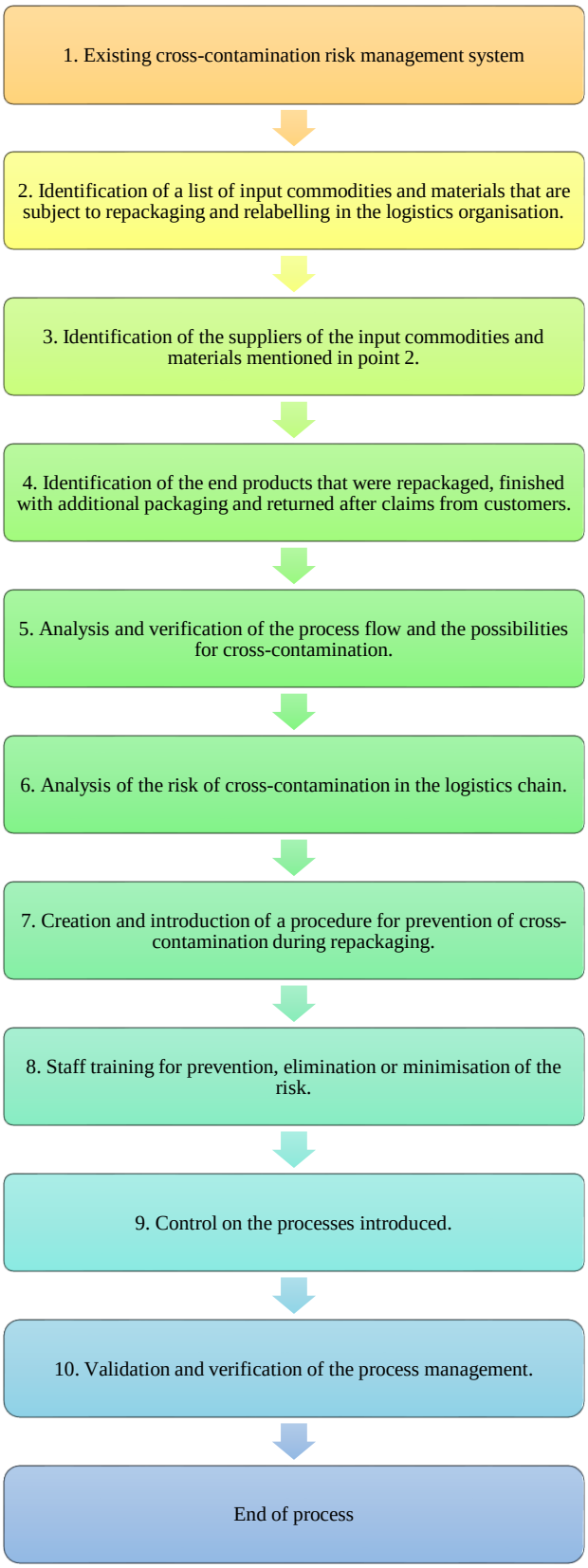

Fig. 1. Cross-contamination risk management model during the packaging and repackaging of products in the logistics companies. (Source: Own research)

III. RESULTS

The elimination of all possible risks of product cross-contamination in the logistics chain is virtually impossible due to the wide variety of products handled in this chain. The possible effects can be sought in the reduction of the risks and minimising their impact through an analysis that is adequate to the actual situation and effective management of the logistics processes. The most significant risks of cross-contamination in the chain are associated with the reverse logistics, when consumers or customers return the goods that had already been delivered to the logistics warehouse for some reason. The cross-contamination management model was applied as a series of 11 steps (figure 1), starting with the identification of inputs and products containing ingredients that pose risk of cross-contamination (allergens, microbiological contamination, etc.), identification of the risks based on the actual conditions in the logistics warehouses and the implemented processes and defining appropriate control measures for the actual conditions in the logistics warehouse to be set in the process management programmes as part of the quality management system. These stages are detailed in the next part of the paper.

A. Analysis of the existing cross-contamination risk management system

The logistics organisations examined in this paper have cross-contamination risk management procedures in place. The introduced procedures allow a certain level of control on the probability of accidental or deliberate product contamination. The risk from the processes associated with reverse logistics was not assessed in any of the studied companies.

B. Identification of a list of input commodities and materials that are subject to repackaging and relabelling in the logistics organisation

This stage involves creation of a list of all input and output products for each individual logistics warehouse. The list should be completed with all used inputs and materials that could cause cross-contamination. There should be a focus on the products with complex composition that could also be used as ingredients in the packaging and repackaging of the products. After the creation of the list, the collected information was analysed and summarised in a special form created for this purpose.

C. Identification of the suppliers of the input commodities and materials mentioned in point B

During this step all suppliers of input commodities and materials were identified. The risk was analysed with focus on the goods exposed to a higher risk of cross-contamination with the suppliers. Attention was paid both on the possible omissions in the labelling of the goods and on the possible risks of deliberate or unintentional cross-contamination. The team conducting the analysis reached to a consensus on the clear distinction between high-risk and low-risk products. The possible decisions with respect to high-risk products that should be taken were identified as follows:

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- Effective auditing on the supplier and undertaking plans for corrective actions in case of established non-conformities during the audit;
- Appropriate labelling of the products with signs and symbols to inform the consumer about the possible risks of cross-contamination;
- Implementing steps for minimising the risk of contamination in the new supplier selection procedure.

D. Identification of the end products that were repackaged, finished with additional packaging and returned after claims from customers.

During this step of the process all end products exposed to a risk of cross-contamination were identified. After the identification a list was created summarising the details about the possible potential and actual risk of contamination of the finished products. The focus was on the products that were part of the processes implemented in the warehouse for packaging, repackaging and products returned by customers after claims.

E. Analysis and verification of the process flow and the possibilities for cross-contamination.

This stage included confirmation of the place of the process flows of inputs and materials in the logistics warehouse from the moment of receiving the inputs and goods to the time of shipping the finished product to the customer, as well as the warehousing of the products returned by the customers. All process stages with identified high risk of cross-contamination were considered in detail and all the necessary subprocesses and operations were identified to allow analysis of all secondary activities:

- Inputs used by the goods suppliers which could contaminate the supplied products;
- The processes for procurement of goods and the possibilities for cross-contamination of flows during the implementation of operations that are exceptional and not foreseen in the routine operation of the warehouse;
- The processes of storing inputs and products where incorrect storage compatibility is possible during periods of peak overloading of the warehouse premises;
- The processes of handling the goods in case of damage of the warehouse equipment;
- Storage of the materials used during the packaging and repackaging of the product;
- The processes of temporary storage and handling of the intermediary product;
- The presence of persons external to the organisation in the warehouse who are servicing or handling the product;
- Rules for wearing protective clothing by the warehouse staff;
- The processes related to cleaning and disinfection of the warehouse premises;
- The processes of management of products that are not fit for consumption, products past their expiration date and waste during the operational work;

F. Assessment and analysis of the risk of cross-contamination in the logistics chain

This stage involved a risk assessment. During the analysis all goods were divided into three groups based on the assessment given by the experts and the consensus reached between them.

- Products with a very low risk class that should be managed by using the introduced customary control measures.
- Products with a moderate risk class that should be managed by using the operational programmes for management of the specific risk and the relevant control measures.
- Products with a significant risk of contamination that should be managed by introducing plans for control of cross-contamination. These products could be potentially contaminated with other products, the staff protective clothing, by dispersing and spilling liquids and powder mixtures or as a result of inadequate cleaning.

G. Creation and introduction of a programme for prevention of cross-contamination during repackaging

The cross-contamination risk management programme introduced in the logistics also involved measures for protecting the products handled. There were numerous rules in this programme, with the most important of them being:

- To clean and disinfect the warehouse premises, the staff changing rooms and the equipment immediately after handling high-risk products and after the end of the warehouse working day, if possible;
- To avoid the temporary storage of unpacked products in bulk or in a liquid state;
- To introduce zoning between high-risk and low-risk products, as well as clear identification of these zones and the relevant warning pictograms;
- To designate a zone in the warehouse for storage of products returned after claims, which should be physically distant from the zone of the high-risk products that are subject to packaging and repackaging;
- To prevent the simultaneous packing and unpacking operations of two high-risk products of different composition and type;
- To make a distinction between zones for high-risk products and zones for cleaning and disinfection chemicals;
- To exercise appropriate effective control to ensure that the waste from the packages of the unpacked products will not create conditions for cross-contamination;
- To minimise any unnecessary movement of equipment, inputs and materials.

H. Staff training for prevention, elimination or minimisation of the risk

The necessary trainings for preventing cross-contamination in the logistics operations should cover the entire staff present, including the temporarily hired warehouse workers. Training is the most appropriate method for familiarising the staff with the newly introduced programmes for risk management and risk minimisation and mitigation to acceptable levels.

I. Control on the processes introduced

Control should be exercised with the necessary frequency based on the conditions and risks for the respective logistics warehouse. Exercising effective control should be followed by verification in records and documents by the person who exercised control. This will allow the person authorised by the management to verify the quality and safety of the product before it leaves the warehouses for marketing in the retail network.

J. Validation and verification of cross-contamination risk management in logistics

Validation was performed by collecting evidence for records about the application of the risk management procedures and programmes introduced, along with verification that the measures are sufficient to control the hazard of cross-contamination within a certain acceptable level. In the course of the study, simulation and playing of "the worst scenario" with respect to the studied risks was performed. Several products were analysed in an accredited laboratory. The results from the analyses confirmed that the introduced risk management system was effective and consistent with the specific conditions for each logistics site. The risk of cross-contamination should be periodically verified on an annual basis in order to confirm whether the applied risk management methods are relevant or changes need to be implemented. The verification confirmed that the consistent management of cross-contamination was effective and provided the necessary level of efficiency. In addition to the analysis of the operations applied for verification of the system, monitoring and measuring activities, daily visual control and internal and external audits by an accredited body were performed.

IV. CONCLUSION

The prevention and minimisation of the risks of cross-contamination in logistics require the introduction of policies, programmes and rules for their effective management. The main purpose of the management of these risks is to ensure the safety of the products in the warehouse and the products supplied to the end user. Irrespective of the introduction of such good logistics practices and effective control, the risk cannot be eliminated completely. An integrated approach is necessary, along with management of the food safety during all steps of the logistics operations management process in order to reduce or prevent the risks. The model presented in this study can support the proper management of the processes, so that the end user in the logistics chain receives products that are safe for human consumptions and where the cross-contamination risk is minimised.

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