POLISH JOURNAL OF NATURAL SCIENCES
Abbrev.: Pol. J. Natur. Sc., Vol 31(4): 637–652, Y. 2016

CRITICAL TRACEABILITY POINTS IN A MASS CATERING – A PRACTICAL APPROACH

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Key words: food traceability, CTP, critical traceability points, catering, mapping of traceability.

Abstract

In view of the very broad scope of purchased raw materials and produced meals, mass catering facilities belong to those food chain links, in which product traceability is very limited, and the available literature does not provide information concerning the traceability of materials used for producing meals. The study involved development of maps showing the material and information flow for catering processes carried out in a mass catering facility of a closed type, thus making it possible to identify critical traceability points (CTP). The results obtained proved that the catering process was characterised by numerous CTPs and an analysis provided a basis to establish corrective actions, enabling improvements of the traceability system under analysis. As a result of those measures, a system of labelling material and meal batches was introduced, together with ID cards and registers, which led to the elimination of the majority of CTPs identified. The result of the research can significantly improve the area of traceability in food safety management systems used in mass catering facilities.

KRYTYCZNE PUNKTY IDENTYFIKOWALNOŚCI W ŻYWIENIU ZBIOROWYM – PODJEŚCIE PRAKTYCZNE

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Słowa kluczowe: identyfikowalność żywności, CTP, krytyczne punkty identyfikowalności, żywienie zbiorowe, mapowanie identyfikowalności.

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Abstrakt

Ze względu na szeroki zakres zakupowanych surowców oraz wytwarzanych potraw zakłady żywienia zbiorowego należą do tych ogniw łańcucha żywnościowego, w których identyfikowalność wyrobów jest bardzo ograniczona, a w dostępnej literaturze brakuje informacji dotyczących identyfikowalności materiałów stosowanych do wytwarzania potraw. W badaniach opracowano mapy przepływu materiałów i informacji dla procesów gastronomicznych realizowanych w zakładzie żywienia zbiorowego typu zamkniętego, które umożliwiły zidentyfikowanie krytycznych punktów identyfikowalności (CTP). W badaniach ujawniono, że proces gastronomiczny charakteryzuje się licznymi CTP, których analiza stanowiła podstawę ustanowienia działań korygujących umożliwiających udoskonalenie analizowanego systemu identyfikowalności. W wyniku tych działań wprowadzono system znakowania partii materiałów i potraw, karty ID oraz rejestry, które umożliwiły eliminację większości zidentyfikowanych CTP. Wyniki pracy mogą znacząco usprawnić obszar identyfikowalności w systemach zarządzania bezpieczeństwem żywności funkcjonujących w zakładach żywienia zbiorowego.

Introduction

Traceability, understood as the ability to track the history, use or location of the analysed subject (*Quality management systems*... ISO 9000), with regard to food covers activities directed towards identification of the origin and location of all components of the food product, as well as activities aimed at identification of all recipients of the product under examination (DZWOLAK 2008, DZWOLAK 2008a, *Food safety management*... ISO 22000)). Tracking (MOUSAVI et al. 2002), also referred to as "traceability forward" (KELEPOURIS 2007) or "tracing forward" (ANON 2007), with reference to food products means the ability to trace the path taken by any specific food product unit between individual links of the food chain (ANON 2007). Tracing (DUPUY et al. 2005, CAC/GL 2006), also referred to as backward traceability (JANSEN-VULLERS et al. 2003) or tracking back (ANON 2007) denotes the ability to establish the origin of a specific unit and/or batch of a food product located within the food chain on the basis of available records (ANON 2007).

Traceability assurance is required by the EU Food Law, under Art. 18. of Regulation (EC) No. 178/2002 (Regulation 178/2002). Additionally, a traceability system is a key element of all food safety and quality management systems and is one of the basic requirements of such standards as *Food safety management*... ISO 22000, ISO 9001, BRC, IFS and GlobalGAP (CZARNIECKA-SKUBINA and NOWAK 2012, DZWOLAK 2009, MAI et al. 2010).

Implementation of the traceability system makes it possible to gain several advantages, the most important of which include improvement of production management and product distribution management, as well as improved management of nonconforming products, particularly in the phase of withdrawing the nonconforming product from the market, which can be reflected

in the reduction of costs resulting from complaint procedures or a food crisis (DUPUY et al. 2005, ANON 2007, FOLINAS et al. 2006, KIJOWSKI and FABISZ--KIJOWSKA 2008, PINTO et al. 2006). In the context of improving food safety or quality management systems, the most important advantage of the effective traceability system is the possibility to quickly identify and eliminate the cause of producing a nonconforming/unsafe product (DZWOLAK 2008a, ANON 2007, SALTINI and AKKERMAN 2012).

The literature on the subject includes mostly publications dealing with traceability in the food processing industry (RUIZ-GARCIA et al. 2010, SALTINI and AKKERMAN 2012), as well as at the stage of obtaining raw materials of plant (CANAVARI et al. 2010, HU et al. 2013, MANOS and MANIKAS 2010) and animal origin (BYKOWSKI and LOREK 2005, DONNELY et al. 2009, GÓRNA 2012, MOUSAVI et al. 2002, RANDRUP et al. 2008, SMITH et al. 2008). In view of the importance of quick identification of the products in the traceability system, particularly with the application of Global Solution One (GS1) and RFID systems (DZWOLAK 2009), the subject of many publications concerns applications of those types of IT systems for supporting the traceability of raw materials and food products (CZARNIECKA-SKUBINA and NOWAK 2012, KELEPOURIS 2007, PAPETTI et al. 2012, ZHANG et al. 2010). However, there are no available publications taking up the issues of traceability in catering processes. In this area of the food chain, operations carried out within the traceability system aim at reconstructing the meal production history, including determination of the type and the origin of the materials used (raw materials, additives, etc.), as well as identification of persons and conditions related to meal production (DZWOLAK 2008).

Objectives

The aim of the research was to improve the system of internal traceability in a mass catering facility by mapping the flow of materials and information, identification of critical traceability points (CTP), and defining corrective actions in order to enhance the traceability system in the facility. The scope of the research covered the system of internal traceability in the catering process, from purchase of food raw materials to serving of ready meals. The subject of the research was the internal traceability system in a closed-type catering facility.

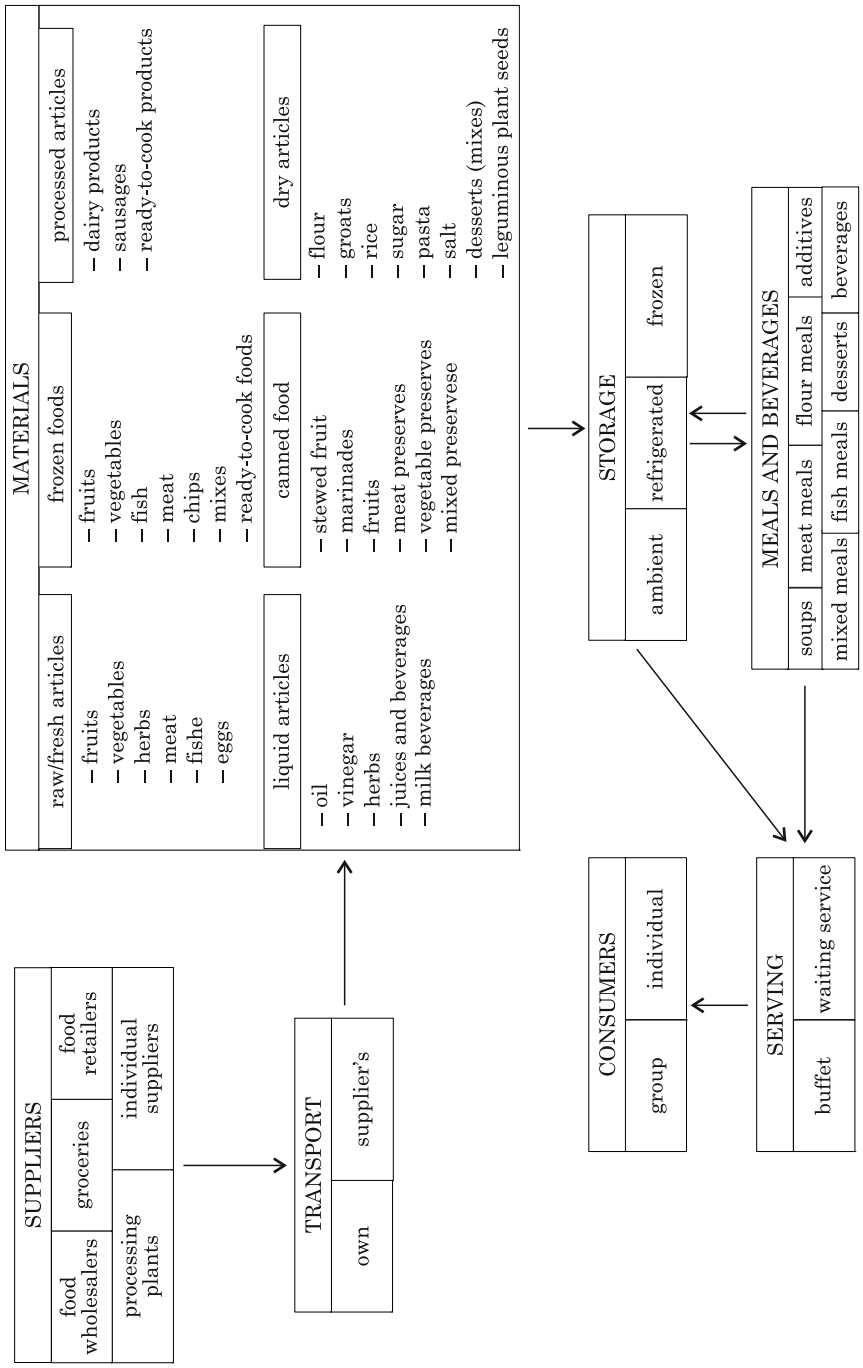

Fig. 1. Map of material and information flow

Materials and Methods

Internal audit and mapping of the flow of materials and information

The research methods included an internal audit of the system, mapping of the material and information flow, CTP identification and establishing corrective actions necessary to improve the traceability system in the facility.

On the basis of direct observations and the analysis of the available documentation of the facility, the audit criterion was developed in the form of the list of control questions, which provided a basis for the internal audit concerning the traceability system in the analysed mass catering facility (MCF). The internal audit was performed according to the audit methodology (DZWOLAK 2009a, DZWOLAK 2010), and its aim was to determine the flow of materials and information related to product traceability. The scope of the audit covered all purchased raw materials, additives, seasonings and packages, as well as products for direct consumption, semi-finished products and products intended for refrigerated and frozen storage.

On the basis of the internal audit, a map of material and information flow was prepared, including the stage of receiving deliveries, storage of purchased materials, production and storage of meals, as well as their serving (Figure 1).

CTP identification

Critical Traceability Points (CTP) mean those spots in which the continuity of the information chain, necessary to establish the origin or location of the food product, is broken (KARLSEN and OLSEN 2011). A decision concerning determination of the piece of information under analysis as a CTP was taken on the basis of a developed decision tree, referring to the location of materials/meals, stopping the process of taking out/withdrawing meals, links between materials (raw materials, additives, seasonings) and meals or between meals and materials, as well as to usefulness of information for establishing the cause for producing nonconforming/unsafe meals (Figure 2).

Corrective actions

After analysing the maps of material and information flow and the CTPs identified, corrective actions related to improving identification of material batches and product batches were formulated.

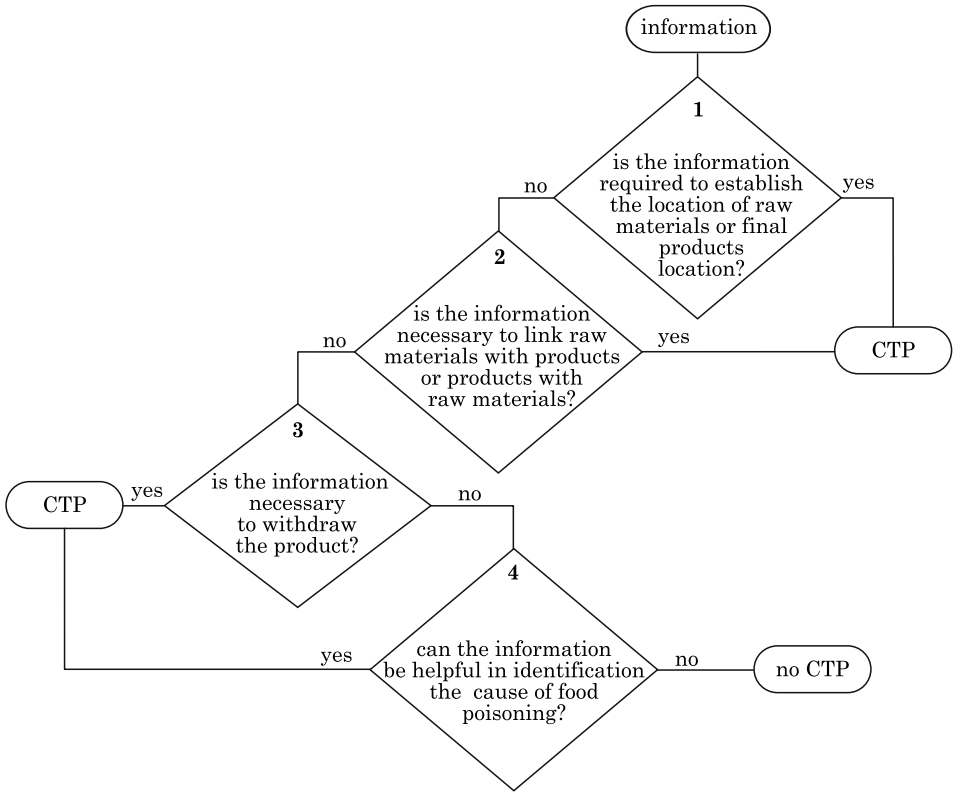

Fig. 2. Decision tree for CTP identification

Verification of corrective actions

After eight weeks following implementation of the corrective actions, the improved traceability system was verified. Three meals selected at random – one from the freezer, one from the refrigerator and one directly from the kitchen – were the subject of verification. The aim of this stage of the research was to evaluate the efficiency of the corrective actions applied by checking the continuity of two-way flow of information concerning the above mentioned meals, and the final determination of the scope of the internal traceability system in the facility.

Results and Discussion

Internal audit and mapping the flow of materials and information

The results of the audit concerning the internal traceability system of the MCF under analysis revealed that the system had various points in which continuity of information concerning identification (labelling) and/or location of materials was not assured. As results from the map of material and information flow (Figure 1), the continuity of information flow was ensured at the stage of receiving deliveries of materials only with reference to transport means. At this stage, the continuity of information broke when materials were transferred to their storage locations, except for eggs which were always stored in the designated and labelled refrigerator. A loss of traceability chain continuity between receiving deliveries and storage of materials resulted from the lack of labelling for the batch of materials received by MCF, as well as from the fact that materials were stored in several unmarked refrigerators, freezers and rooms (Figure 3). Also, at the storage stage, some dry goods (e.g. groats, beans and peas), vegetables and fruit, bread as well as unpacked articles (e.g. cured meat and raw meat) were placed in collective containers. This resulted also in mixing various batches of materials, which brought about a loss of information flow continuity. Those observations correspond to previous reports by other authors, who indicated mixing of batches as one of main difficulties emerging in traceability systems (DUPUY et al. 2005, SALTINI and AKKERMAN 2012).

The lack of possibility to identify batches of materials and their origin, except for eggs, was also noticed for meal production. No methods of recording the name, the batch or other forms of identifying materials were used at this stage, in spite of the fact that identification of the batch of material/ product is a crucial element of the recall and product withdrawal procedures as well as searching for the cause of the nonconforming product (DZWOLAK 2009, ANON 2007). Although this situation is typical for many catering facilities, it is unacceptable in the aspect of food safety assurance and public health, since it enables undertaking effective corrective actions in case of food poisoning.

CTP identification

Critical traceability points are determinants of the traceability system completeness. CTPs identified in this research (Figure 2) were a consequence, first of all, of the lack of labelling batches of received materials at their storage stage (CTP1-CTP10) and while making the meals (CTO11-CTP20). Other

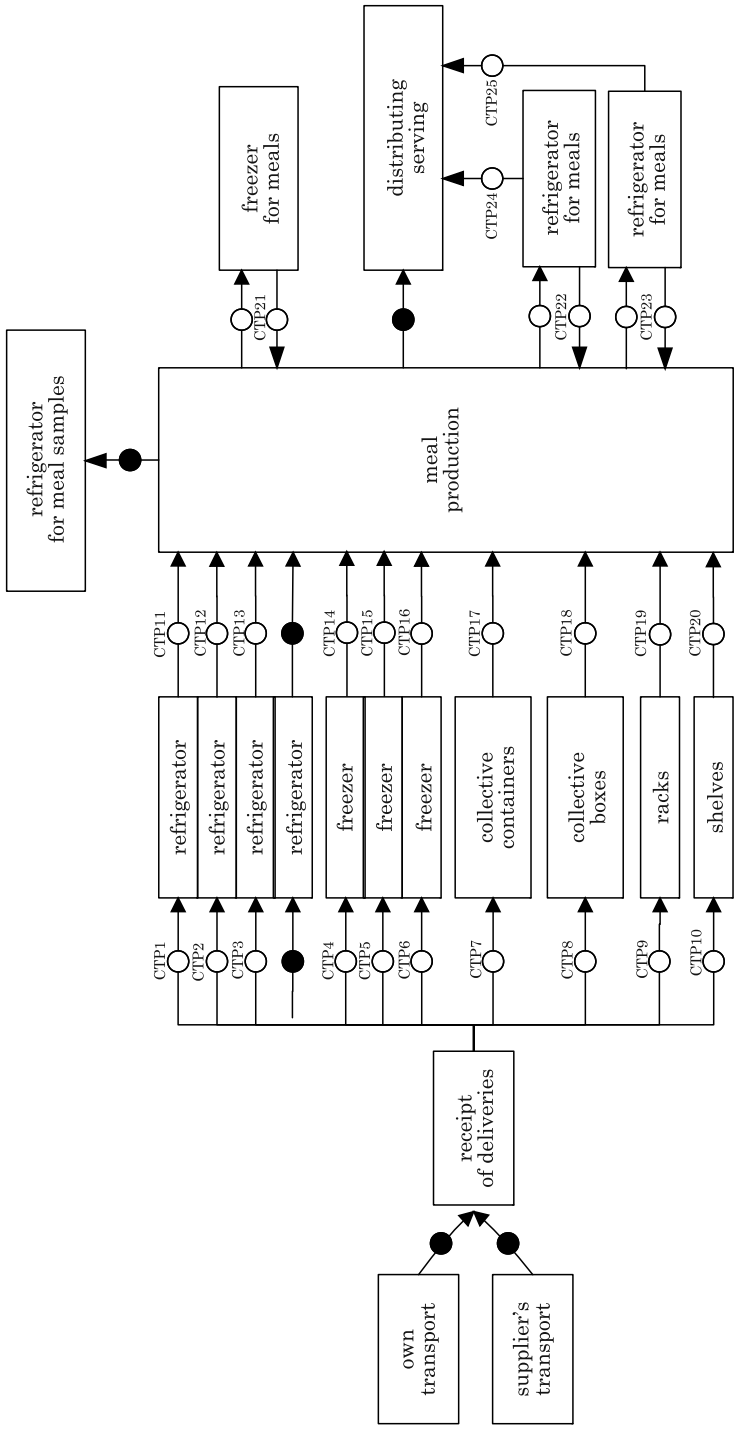

Fig. 3. CTPs in the catering process under analysis: • – information continuity, o – information discontinuity

CTPs (CTP21-CTP25) resulted from the lack of identification labels on semi-finished products and meals at their frozen storage (CTP21) and refrigerating storage stage (CTP22-CTP25) – Figure 3. Those results correspond to the findings by KARLSEN and OLSEN (2011) and KARLSEN et al. (2011), who explained CTPs identified in fish farming by mixing the batches of fodder components and the lack of explicit labels on traceable units.

Meal production in mass catering facilities is not of the serial production type, except from mass events and the so-called system gastronomy (CZARNIECKA-SKUBINA et al. 2009), which to a great extent hinders assurance of information flow continuity and generates numerous CTPs. Additional difficulties in this regard result from the fact that catering facilities are characterized by significant diversity of suppliers and their high rotation, particularly in summer and autumn seasons. The emergence of CTPs in the analysed MCF was also influenced by specific conditions typical for catering facilities, resulting first of all from a wide range of meals produced, as well as from numerous batches of materials (raw materials, additives, seasonings, etc.) and varied sources of their origin (DZWOLAK 2013). Numerous batches of raw materials and manufactured products result in increasing the so-called dispersion of batches of raw materials and products, which is indicated in the literature as one of the reasons for lowering the efficiency of the traceability system in a food chain (DUPUY et al. 2005, SALTINI and AKKERMAN 2012).

Corrective actions

In view of the fact that the primary problem reducing the effectiveness of recalls and withdrawals of products and identification of causes for the emergence of nonconforming products is the impossibility to determine the batch of materials (ANON 2007), the first step was to define a batch of materials (raw materials, additives and packages)[1] supplied to the MCF, as well as a batch of products (semi-finished products and final meals)[2]. This operation was necessary for clear identification of materials originating from various sources, and also provided the basis for applying an appropriate system of labelling material batches (ANON 2007, SMITH et al. 2008).

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[1] Production/distribution unit (net weight, number of pieces, package, multi-pack, box container, etc.) of materials originating from one supplier, produced in uniform production conditions and delivered to MCF at the same time.

[2] Production unit of MCF products (pieces of net weight) produced in uniform conditions, at the same time, by the same persons, using the same equipment and kitchen appliances.

In case of catering facilities, introduction of sophisticated information technologies, such as GS1 bar codes or RFID transponders (CANAVARI et al. 2010, CZARNIECKA-SKUBINA and NOWAK 2012, HU et al. 2013, PAPETTI et al. 2012) is not economically viable. Taking into account the fact that simple traceability schemas based on manually prepared records and documents have been used in production and food trade facilities for many years (ANON 2007, FOLINAS et al. 2006, GÓRNA 2012), the chosen solution was well-suited to the technical and economic possibilities of the MCF under analysis. For the labelling of material batches, the system of stickers/notes/tags with written code of the material batch was used, of the following general pattern:

$$000/0/00/A \tag{1}$$

where:
000 – subsequent day of the year
0 – subsequent number of batch on a given day
00 – subsequent number of material batch in the same delivery,
A – place code.

In order to ensure full identification of materials received, the given batch code was entered together with the name of the material and the number of invoice or another proof of purchase in the "Delivery register" book created. Due to difficulties in identifying some supplies of vegetables and fruit, the group of accidental suppliers from marketplaces was excluded from the group of suppliers.

To precisely designate the storage place (location) of a given batch of materials, stickers/notes showing the code were used for labelling freezers (Z_1, Z_2, Z_3), refrigerators (C_1, C_2, C_3, C_4), racks and other places where the above-mentioned materials were stored (Figure 4). Those labels also provided the code of the storage place, which was recorded together with the batch code (pattern 1).

At the meal production stage, the use of the so-called identification cards (ID cards) between the storeroom and the proper kitchen was introduced. While collecting the material from the storeroom, a cook or a cook helper copied the batch number from the label onto an ID card and entered the proper place code (of the freezer, the refrigerator, etc.). The ID card was brought together with the collected material into the kitchen and was then placed in the labelled container (Figure 5). ID cards were kept in the container until the end of the shift and were then transferred to the envelope marked with a date and stored for 72 h (in case of directly served meals) or by the end of their use-by date (frozen products).

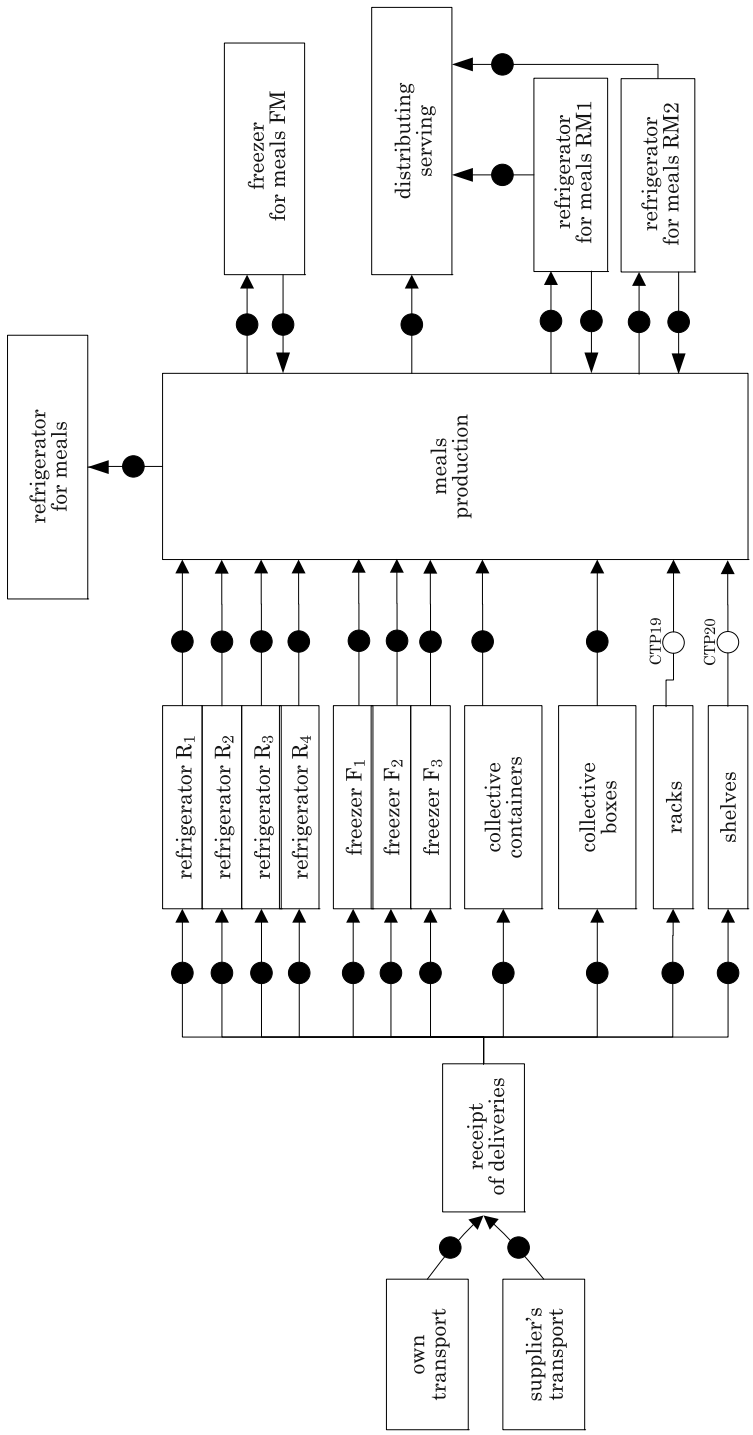

Fig. 4. CTPs after introduction of corrective actions: • – information continuity, o – information discontinuity

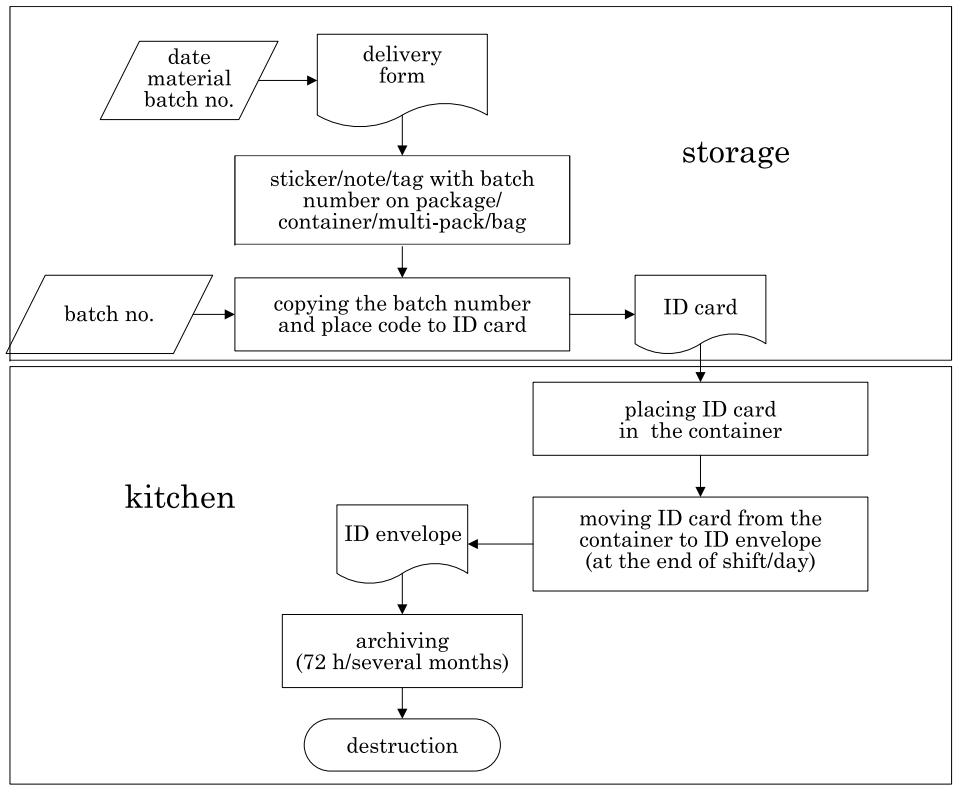

Fig. 5. Corrective actions – flow of information with regard to the origin of materials used for meal production

In this way, the ability to identify all material batches used for producing meals on a given day was ensured. In combination with the above-described corrective actions at the stage of receiving and storing the material, it was also possible to establish the origin (suppliers) of the materials of which the meals were produced on a given day.

The last group of corrective actions was related to labelling batches of ready meals and semi-finished products stored in refrigerators and freezers. In this case, labelling was used in the form of stickers or notes specifying the day of production, the date and time of packing, as well as the date and time by which the meal should be consumed or the semi-finished product should be used. To identify samples of meals collected during mass events, a description of samples was used, specifying the name of the meal, the date of its production and the time when the sample was collected.

While implementing corrective actions in the MCF analysed, a fundamental problem was the additional load for employees related to new duties of labelling the batches and use of ID cards. For the first three weeks of using a new batch identification and traceability system, employees also had problems with the proper performance of activities related to the new system. Those observations correspond to information provided in the literature, according to which simple systems based on manual records are laborious and time-consuming (PINTO et al. 2006, ANON 2007). Unquestionably, the application of modern IT technologies (e.g. RFID or GS1) significantly improve the rate of operation and improve the efficiency of the entire traceability system (GÓRNA 2012, MANOS and MANIKAS 2009), but solutions of this type exceed the financial possibilities of most MCFs and are applied only by large restaurants and catering businesses. In the context of improving the rate of information flow, at moderate financial cost, the introduction of barcode printers and readers could be a good solution.

Verification of corrective actions

The scheme of the identification procedure with marked traceability elements and proper documents and records is presented in Figure 5. For all three samples, it was possible to reconstruct the history of the meal production, establishing technological parameters, health condition of employees participating in the production of the analysed meals, registered technological parameters, materials used for the production of meals, conditions for their receipt and storage, as well as the origin of those materials (identification of suppliers). Additionally, for the meal selected directly from the kitchen, it was possible to identify and locate the sample of this meal (Figure 6). The obtained scope of the analysed traceability system from the meal to the material suppliers confirmed the effectiveness of corrective actions applied and it was compliant with the minimum requirements defined in the Regulation of the European Parliament and the Council No. 178/2002 (Regulation 178/2002).

The applied methodology of material and information flow mapping, CTP identification and implemented solutions improving the traceability system in the facility can be also used in other mass catering facilities. Nevertheless, a basic limitation of this established traceability system is employee turnover. Newly recruited employees must, at least for a few weeks, adjust to the required procedures, and if the employee turnover rate is too high, the system may be destabilised. However, this constraint does not result from the specific character of the system described, but it is conditioned by the specificity of the catering industry, in which some closed-type facilities (e.g. resort hotels) are closely related to the seasonal character of the tourist activity.

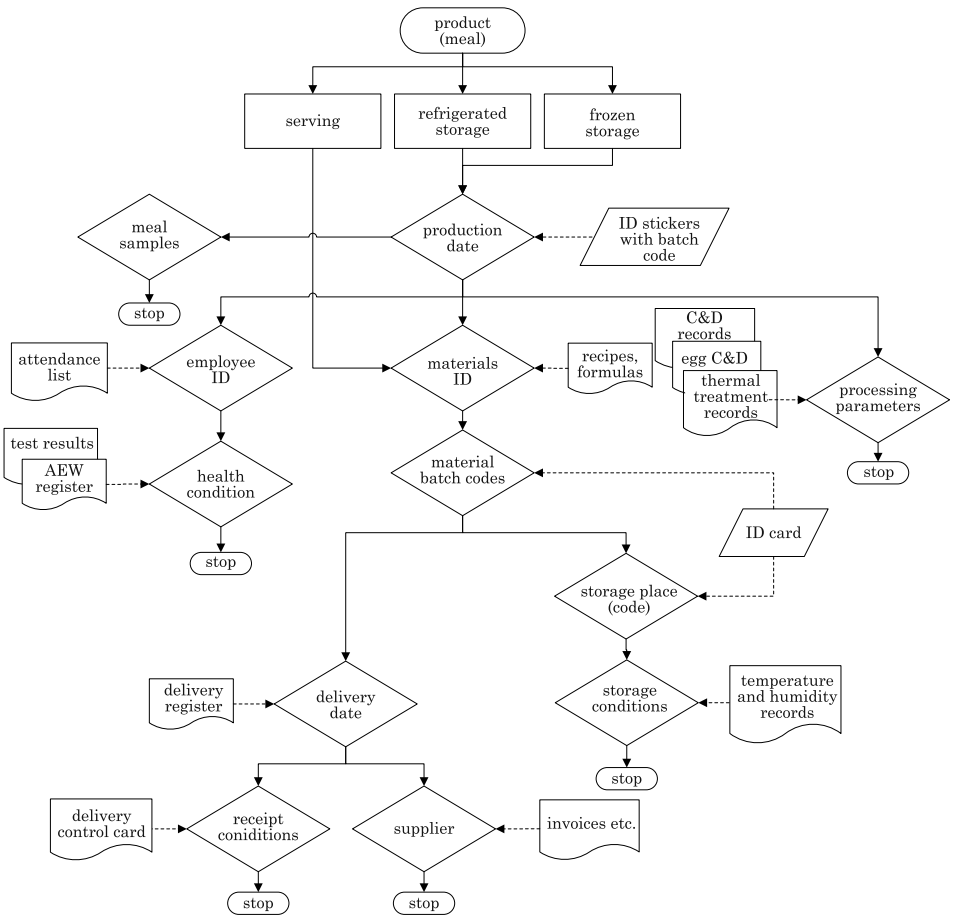

Fig. 6. Scheme of internal traceability verification after implementing corrective actions: AEW – records concerning admission of employees to the workplace, ID – identification, CandD – cleaning and disinfection. A dashed line is used to mark the flow of information available in the existing records

Conclusions

1. Numerous critical traceability points (CTP) established in the analysed catering process were a consequence of a partial or total loss of information flow (concerning location of materials or meals) as a result of mixing various batches at the storage stage or during refrigerated and frozen storage of semi-finished products or ready meals.

2. In order to improve the traceability system through reduction of CTPs in the analysed mass catering facility, it was necessary to introduce numerous

corrective actions. Those measures consisted, first of all, in introducing a labelling system for material batches at the stage of their delivery, and the batches of materials stored under refrigerated and frozen conditions. The system of material purchases also required some corrections, in which occasional suppliers were eliminated and the register of suppliers was established, with reference to internal codes of material batches and place codes.

3. As proven during the practical verification of the corrective actions introduced, the possibility to trace the product from serving the meal to material suppliers as well as from the material suppliers to serving ready meals was able to achieve.

4. The mapping of material and information flow applied in this study, combined with CTP identification and establishment of corrective actions, which included coding and labelling material batches and meals as well as the introduction of identification cards, made it possible to improve the internal traceability system in the facility. These results may be useful for designing traceability systems in mass catering facilities.

Translated by Biuro tłumaczeń „Oscar" w Olsztynie

Accepted for print 18.07.2016

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