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## **REDUCTION OF LOSSES IN THE DISTRIBUTION OF DAIRY PRODUCTS AS PART OF PRODUCT MANAGEMENT<sup>1</sup>**

**Abstract:** Managing product distribution processes in the dairy chain is an essential area of product management processes, and it involves the possibility of reducing the losses of such products. Thus far, the available literature has been void of information on the relations between these occurrences, which prompted the authors to undertake an analysis of the aforementioned processes as well as to conduct an empirical investigation. The purpose of the investigation was an analysis of the conditions for the distribution of the products and the methods of managing dairy products at a selected distribution centre, using the loss risk analysis and the Ishikawa Diagram, in order to identify the locations and volumes of losses concerning these products. The investigation was conducted at a specialised dairy centre in the vicinity of Siedlce, in 2013 and 2014. Internal documents concerning controlling the conditions for the transport processes were subjected to a detailed analysis. On this basis, an analysis of quality loss risk exposures in the transport and storage of dairy products at the distribution centre were carried out. The losses of dairy products were assessed at the level of 0.64% of the volume of the distributed products. However, the need to reduce losses in the distribution processes of dairy products

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requires that new product management procedures be developed in order to ensure the quality of these products.

**Keywords:** product management, food losses, dairy chain, risk analysis, distribution centre.

**JEL classification:** D29, D33, L66, M11, O13, Q01, Q18, Q51, Q57.

### ZARZĄDZANIE PRODUKTEM W KONTEKŚCIE OGRANICZENIA STRAT W DYSTRYBUCJI PRODUKTÓW NABIAŁOWYCH

**Streszczenie:** Zarządzanie procesami dystrybucji produktów w łańcuchu mleczarskim stanowi ważny obszar procesów zarządzania produktami i oznacza też możliwość ograniczenia strat tych produktów. Jak dotychczas w dostępnej literaturze brak jest informacji na temat relacji pomiędzy tymi zjawiskami, co skłoniło autorów do podjęcia analizy wymienionych procesów oraz do przeprowadzenia badania empirycznego. Celem badania była analiza warunków dystrybucji produktów i metod zarządzania produktami mleczarskimi w wybranym centrum dystrybucji, z wykorzystaniem analizy ryzyka strat i diagramu Ishikawy, dla określenia miejsc powstawania i wielkości strat tych produktów. Badanie zostało przeprowadzone w specjalistycznym mleczarskim centrum w 2013 i 2014 roku w pobliżu Siedlec. Szczegółowej analizie zostały poddane wewnętrzne dokumenty kontroli warunków procesów transportu. Na tej podstawie przeprowadzono analizę ryzyka powstania strat jakości w transporcie i przechowywaniu produktów mleczarskich w centrum dystrybucyjnym. Straty produktów mleczarskich oszacowane zostały na poziomie 0.64% objętości dystrybuowanych tych produktów. Potrzeba zmniejszenia strat w procesach dystrybucji produktów mleczarskich wymaga jednak opracowania nowych procedur zarządzania produktem dla zapewnienia jakości tych produktów.

**Słowa kluczowe:** zarządzanie produktem, straty żywności, łańcuch mleczarski, dystrybucja, analiza ryzyka.

## Introduction

Food losses imply a reduced supply of food utilised in accordance with its intended purpose, resulting from mismanagement, errors and irregularities in the processes of managing it, including improper management, all taking place from the phase of production to the phase of distribution to end users. In Poland, nearly 9 million tonnes of food is wasted annually as a result of

losses and mismanagement, which ranks our country in fifth place among producers of food waste in European Union countries [FAO 2013]. The responsibility for food losses rests on all of the food chain links, and therefore actions aimed at reducing such losses should be taken at each one of them. An essential area in this respect is knowledge on the mechanisms of generating losses and the processes of loss mitigation management. The problem of food losses does not only concern the scale of the occurrence but also the subsequent handling of the products withdrawn from the market while these are stored and processed, which has a negative impact on the natural environment [Krajewski et al. 2016].

The kinetics of qualitative changes in the production and distribution processes during the lifetime of products should be perceived, in accordance with the principles of commodity research, through the prism of sustainable development [Żuchowski 2008]. The qualitative changes of food products, as analysed against the background of their environmental impact, require the assessment of these processes, not only in the phase of shaping and using the products, but also in the phase of disposal thereof, with reference to possible recycling options [Zalewski 2004; Pilarczyk and Nestorowicz 2010]. At the same time, this is an area of interest for product management processes [Doroszewicz 2007]. Taking into account the scarcity of the resources and the barriers to the absorption capacity of the natural environment, the aim should be to close the product life-cycle, wherever possible, through processes of recovering the unmerchantable precious products or the ingredients thereof [Fiksel 2009; Brzustewicz 2013]. This kind of approach is tantamount to embracing the principles of sustainable development and constitutes an important area of interest for commodity research [Żuchowski 2008]. Investigation into the utility value of the recovered products is of vital importance to sustainable development and enables the determination of reasonable guidelines for utilising them in the course of constant process improvement [Żuchowski 2008].

The appropriate management of the product distribution processes in the dairy chain provides the potential to reduce losses from these products and constitutes an essential area of product management processes. Thus far, the available literature has been void of information on the relationships between these occurrences, which prompted the authors to undertake an analysis of these processes as well as to conduct a preliminary empirical investigation. In the presented study concerning the problem of reducing losses of dairy products in distribution processes, evaluation of the analysed occurrences was made with regard to the product management processes in the context

of conditions for distribution processes as well as transport processes that constitute the main areas of these occurrences. The objective of the preliminary empirical investigation was in turn an analysis of the locations and volumes of losses concerning dairy products against the background of the evaluation of conditions for product distribution and methods of managing dairy products at a selected distribution centre in the Mazovia Province in 2013–2014.

## **1. Food product management and losses in distribution processes – the specificity, relations and mutual relationships between the processes**

In the case of food market systems, it can be observed that a specific chain of providing safety and quality can be distinguished in the form of a food chain. This is determined by food-specific and indispensable quality assurance processes and factors, such as: hygiene and keeping cleanliness and safety in the processes (e.g. in the HACCP system), refrigerating and ensuring cold storage until reaching the consumption phase in households. This should possibly comprise the entire distribution channels and the processes of moving raw materials and food products. At the same time, this creates new conditions and tasks for the product management processes in the entire area of moving, managing and offering food products in the market.

Product management constitutes one of the basic functions of production process management, which is typically the responsibility of the producers (suppliers) but increasingly also of the recipients (the commerce). The essence of food product management is made up of all actions and decisions taken by producers in the scope of shaping and developing the product (its features, attributes and properties), its management as well as devising the access of the particular product to the market, also in the realm of commerce, including devising the sales processes. In the new circumstances of the food market, bearing features of a global market, and with an increasing level of losses, product management should be additionally integrated with the processes of recovering valuable products, thus creating an integrated system of links and rationalisation of these processes.

Food product management represents a specific area of knowledge (and of decisions and practical skills) as well as an interest area for many scientific disciplines including mainly the economic sciences: commodity research,

management and marketing, as well as other sciences, technical and agricultural ones. One of the rational actions in the management process is striving to assure the rational management of food products, which also implies the reduction of losses of these products in the food chain.

According to Monier [2010], the most important factors conditioning food losses and wastage along the food chain should include: awareness, knowledge, attitude, preferences, portion size, planning your shopping, storage, social and economic factors, labelling, form and sort of packaging, manner of managing stocks, logistic processes, as well as quality requirements with regard to the product [Monier 2010]. The most common reasons for food losses include mechanical damage to raw and finished products, improper warehousing conditions, breaking the cold storage chain, failure to comply with commerce requirements and ineffective supply chains. Reasons may also include production line malfunctions leading to irregularities, failure to keep the correct mass of the product, errors on packages, etc. An important aspect is also the problem of excessive production and overestimated orders, resulting from errors made while following the market demand mechanisms. This problem is also related to the seasonality of the consumption of the products, as well as the irrational management of the products, especially during sales peaks (holidays, long weekends, etc.) [Krajewski et al. 2014].

The phenomenon of food losses occurs along the entire food chain; with regard to dairy products this is the specific dairy chain. The losses of dairy products can be considered to be a derivative of the organisation of processes (of production or distribution) and the conditions shaping the quality in the dairy chain. They are dependent on the quality of the processes of producing and processing them, as well as numerous other factors: on the quality of the raw ingredients used (milk and additives), transport conditions within the entire chain, the processing technologies applied and the packaging used, on storage conditions at the stage of distribution, as well as the conditions in which these products are sold. This means that in order to assure product quality in the dairy chain it is necessary to comply with the rules of hygiene and cleanliness, cold storage conditions and the minimisation of turnover time during all of the links of this chain: production processes, processing, transport, distribution, warehousing and goods trading. Failure to observe these recommendations leads to losses in the raw materials of dairy products, including precious nutritious ingredients, economic losses due to irrationally managed products as well as the resulting adverse impact on the natural environment.

## **2. Losses in dairy distribution and the product management processes – research results**

### **2.1. Research methodology**

The research area comprised processes of distribution and the transport of dairy products at a distribution centre located in Siedlce, in the Mazovia Province, and the quantitative studies were conducted in the first half of 2013 and comparatively with regard to the process conditions in the same period of 2014. These studies supplement earlier research concerning the logistics of the processes of recovering dairy products [Krajewski et al. 2014].

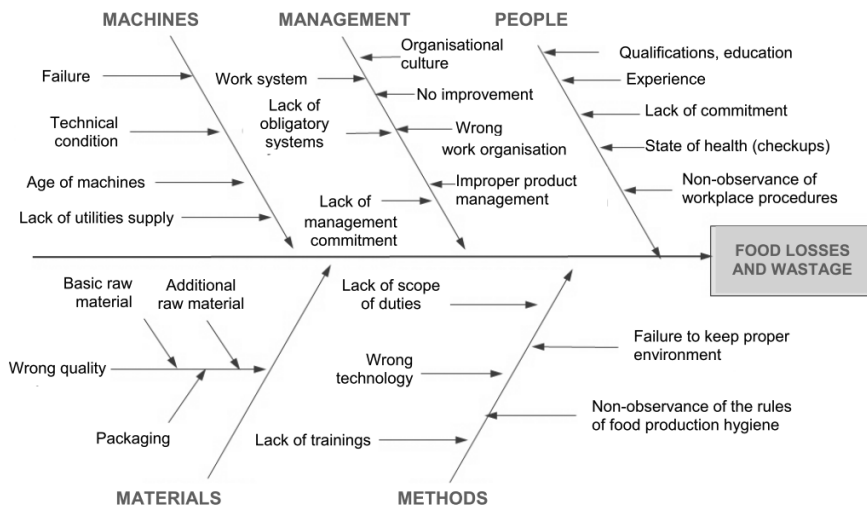
The enterprise under investigation deals with wholesales, packing, and the warehousing of dairy products as well as renting warehouse spaces. The facility has been in compliance with the European Union requirements on commerce since 2004, and has relied on the HACCP and IFS systems since the beginning of its activities.

The method used in order to evaluate the dairy product management processes and to determine the level of losses in the phase of distribution was the one of face-to-face interviews with employees of the individual divisions of the enterprise: transport, warehousing, sales, accounting, and quality management, supplemented by a secondary analysis of the internal documentation of the plant (control cards concerning temperature measurements of means of transport, complaint and return cards, etc.). An important element of the research process was also observations of these processes and our own examination of the technical conditions for conducting the processes.

#### **Product losses in the dairy chain in the light of risk analysis**

The existing few assessments of the volume of losses within the scope of dairy distribution [Jones 2006] as well as the author's earlier research on dairy product trade [Bilska et al. 2014; Wrzosek et al. 2014], give reason to embark on research aimed at providing a precise evaluation of the scale of losses at the stage of distribution, and then to take all effective actions in order to reduce them. One such effective research tool in this respect seems to be the loss risk analysis [Wrzosek et al. 2014]. The first stage of this analysis consists in defining all of the potential reasons to this phenomenon taking into account the characteristic features of the processes. A good research tool is the Ishikawa Diagram (Figure 1) presenting the main determinants that have influence on losses, including the area of managing employees, processes and products.

This is an extremely important aspect of shaping market phenomena and it relates to both the correct organisation of distribution and the product flow processes. All of the elements of the structure of production and distribution processes are interdependent because e.g. reception of an incorrectly labelled package from a supplier for trading (materials), failure to take it into account at the stage of packing the finished product (management) in connection with the human factor (methods – lack of training) will result in a product that cannot be forwarded for further marketing, and this may also result in supplying a product with irregular commercial characteristics [Bilska et al.2016].



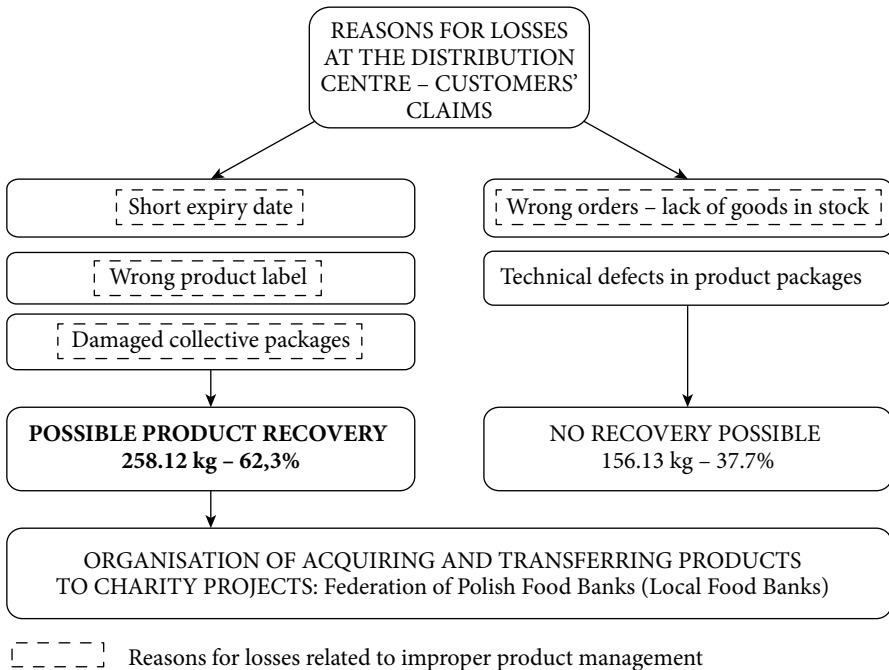
**Figure 1. Reasons for food losses and wastage**

Source: Adapted from: [Wrzosek et al. 2014]

The signalling by relevant entities of the occurrence of the problem of food waste has contributed to actions being taken in order to discern in more detail the reasons and volume of this phenomenon in many countries. Due to the fact that each of the food chain stages is different, this is a very difficult process and in view of the above it has been divided into appropriate sections. In 2014, results were presented concerning the volume of food disposed of and consequently mostly wasted at the logistic centre outside Siedlce. The survey comprised the transport stage.

## 2. Investigation into losses at the dairy products distribution centre – results and discussion

The analysis of the processes of the distribution of dairy products points to the occurrence of losses of these products due to defects in the product management processes, such as the supply organisation, wrong packaging and standardisation of the expiry dates. The analysis comprised the number and characteristics of the claimed products with reference to the reasons for this phenomenon and the option of redistributing them to charitable projects. Figure 2 shows a summary of the level of potential losses of dairy products in the process of distribution through determination of the mass of the claimed products, with reference to the reasons and possible ways of utilising these products.



**Figure 2. Reasons for the losses of dairy products in the distribution processes at the distribution centre under investigation and determination of the possibility of recovering and transferring them to charitable projects**

Overall the losses of dairy products in the distribution process at the centre under investigation was estimated at the level of 0.64% of the distributed

products. The total mass of products claimed by the market (potential losses for the distribution centre) in the 6-month period under investigation was estimated at 414.25 kg, of which 62.3% could be considered as suitable for further consumption. The most common reason for claims recorded in the documentation at the distribution centre was the wrong number of goods in a supply (104.83 kg), which can be considered as an essential error in the process of product management. An essential reason that eliminated the products from the process of recovery and further transfer were major quality defects (51.3 kg), e.g. mould growth due to leaky packaging allowing air migration inside and perishing of the food content. The forming secondary metabolites of mould (mycotoxins) present a hazard for human health, and therefore these products must be disposed of [Kołozyn-Krajewska 2013].

The other reasons for losses of dairy products presented in figure 2, related to a large extent with the processes of product management, are at the same time related to the possibility of recovering them for consumption purposes as suitable for consumption. Such defects in the management processes as failure to take into account expiry dates (especially short dates), erroneously prepared label or external damage to collective packaging do not cause any qualitative changes and do not disqualify these products as suitable for consumption or render them harmful to the consumer's health; nevertheless, they imply elimination thereof from the trade. Wrong logistics and too long transport time make that the customer sees the product with shorter expiry dates. This applies mainly to perishable products. Studies show that consumers are looking for information on products, but a good and frequently used tool to obtain information about it is the label [Labelling 2006]. Moreover, almost 40% of people indicated that they read in the store the information on the label [Report 2005]. These products can still be allocated for consumption by recipients from outside the market (e.g. within charity projects), but as being particularly sensitive, they require separate treatment within the processes of product management.

In the case of the short expiry dates of products, the time to deliver them to consumers is limited, which requires quick organisational action and efficient logistic processes. The development of standards for the management processes in this scope and establishment of an appropriate scheme of action would largely contribute to the reduction of a bulk of products disposed of for this cause because, as follows from the analysis of the documentation at the entity under investigation, a short expiry date was the most commonly observed effect of improper product management – it concerned as much as 223.76 kg of products. Additionally, exceeding the expiry date for dairy

products represented (beside mechanical damages to unit packages) one of the most common reasons (40% of quantitative losses) for formation of losses of dairy products in the retail trade [Wrzosek et al. 2014]. Pursuant to the Act of 25<sup>th</sup> August, 2006 on Food and Nutrition Safety, any food product that has exceeded the expiry date declared by the manufacturer must not be destined for human consumption due to the breaking of the conditions that guarantee the consumer's safety of health, and thus it must be disposed of. It seems that the key area in the management of products (treated as an element of the Corporate Social Responsibility – CSR – approach) in the context of minimising their losses in the supply chain (trade and distribution) is preventing the exceeding of the expiry dates, which will make it possible to use the products for consumption purposes. As an alternative solution, these products can be utilised in such a manner that they are transferred to charity projects. Transferring products with short expiry dates (or with slightly damaged packages) to organisations that care for the needy may become an element of the approach to dairy product management in the context of the CSR approach.

As follows from the presented analysis, in the first half of 2013 the distribution centre under investigation disposed of 258.12 kg of dairy products that were still suitable for consumption. Transferring this mass to the Federation of Polish Food Banks, some local Food Banks or other charitable organisations would not only be an act of charity but it would enable a reduction of costs due to disposal in the investigated period even by half.

### **2.3. Conditions for the formation and reduction of losses in dairy transport**

Due to the needs of the consumers and compliance to the requirements of food legislation, the dairy chain is based on the principle of keeping the cold storage chain, as well as on the choice of appropriate transport technology, which should lead to assuring safety of health and the unaffected quality of the sensitive dairy products. The fact that food is still edible depends on the temperature, humidity and other factors that affect the growth of organisms that cause the spoilage of transported goods [Tanner 2016]. The majority of these products are specific in terms of transport because they are perishables and thus have short expiry dates, which craves for due diligence in the process of managing these products [Krajewski 2010]. In order to satisfy the consumers and supply the right goods meeting the standards and conditions imposed by customers, product storage was to a large extent moved to the transport process and transport management has become the most important issue in

the area of product management in dairy product distribution [Krajewski 2006]. Additionally, features related to commodity research and the handling of dairy products determines the transport technology – the choice of the mode and means of transport as well as the vehicle's construction.

Due to the specific nature of the commodity, dairy products constitute loads sensitive to: duration of transport, temperature changes, and hygienic conditions prevailing inside the means of transport, as well as handling processes at loading and unloading. The most hazardous are undoubtedly the changes in temperature – particularly the changes towards an above zero temperature [Krajewski 2006]. Therefore, it is necessary to provide appropriate temperature protection during the transport, handling and warehousing activities, using specialised multi-chamber refrigerated vehicles providing diverse temperature conditions. Maintaining the optimal temperature during the transport of goods depends on the internal temperature of the load and environment, the speed and manner of handling as well as the rate of biological processes taking place inside the load [Zwierzycki et al. 2009]. Maintaining the appropriate temperatures during the transport of sensitive goods is a necessary condition for assuring their safety to health by preventing the growth of microorganisms [Kołożyn-Krajewska 2013].

The survey of the places posing threats and generating losses in the process of transport was carried out and based on qualitative research into these processes using the method of face-to-face interviews, examining the technical conditions and measurements of the temperature of the means of transport, as well as an analysis of the control documentation of these processes. The trade entity under investigation used the method of taking temperature measurements of the means of transport during the loading and unloading of the goods. As follows from the available control documentation, these temperatures ranged in the investigated period from 5°C to 8°C with the dominant measurement of 6°C. This is confirmed by results of our own temperature measurements inside the chambers of refrigerated vehicles, at a level of 6–7°C. According to the literature, the appropriate range of temperatures for dairy products should be between 4°C–10°C depending on the assortment being transported [Świdorski 2010], so the conditions for maintaining temperature conditions in the investigated process of transport were fulfilled. No losses were found owing to failure to keep the transport conditions as they should be. This was reflected in the survey of the level of product losses in transport that resulted exclusively from damage to collective packaging during transport (2.36 kg), which was caused by inappropriate load securing during transportation.

## Conclusions

The research carried out into the volume of losses at a selected distribution centre of dairy products points to the relatively low level of these losses, assessed at 0.64% of the quantity of these products being the object of trade, and the main source and reason for these losses are limitations related to the expiry dates, amounting to 54% of losses of these products.

At the same time, the analysis of the points where losses are generated and the nature thereof points to the fact that the majority of them are related to the improper management of dairy products, which provides the possibility of recovering them in a form suitable for consumption within charities (for example products with short expiry dates).

No relations are found in the dairy product management between this process and the reducing of food losses and continued extending of the management process towards actions constituting an element of the CSR strategy. The innovative approach to product management in trade and distribution in the context of the CSR may be the key to increasing social awareness in the scope of reducing food losses in Poland.

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