

INTELLIGENT FOOD PACKAGINGS AS A LINK OF COMMUNICATION IN THE CHAIN OF SUPPLY

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Abstract

The aim of this work is an attempt to define the role of intelligent packagings to make the course of logistic food processes more efficient. The implementation of the aim happened by conducting the surveys concerning the meaning of intelligent packagings advantages for the chosen participants of logistic processes in the chain of supply.

The studies were questionnaires and included the following elements of the supply chain: representatives of operational staff of transport companies, warehouses and consumers who are not professionally connected to transport and warehousing from the area of south-east Poland (sampling was accidental).

Statistical analysis was performed using an Anova packet of the Statistica softwear.

The surveys allowed to claim that the representatives of transport companies and warehouses have a high level of knowledge about intelligent packagings and their ratings. Consumers, however, do not know about them much. Varied results of the questionnaires allow to assume about a limited possibility of making logistic processes by using intelligent packagings more efficient.

INTELIGENTNE OPAKOWANIA ŻYWNOŚCI JAKO OGNIWO KOMUNIKACJI W ŁAŃCUCHU DOSTAW

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Słowa kluczowe: opakowania inteligentne, logistyka, łańcuch dostaw.

Abstrakt

Celem pracy jest próba określenia roli opakowań inteligentnych w usprawnieniu przebiegu procesów logistycznych żywności. Realizacja celu nastąpiła poprzez przeprowadzenie badań dotyczących znaczenia walorów opakowań inteligentnych dla wybranych uczestników procesów logistycznych w łańcuchu dostaw.

Badania miały charakter ankietowy i obejmowały następujące ogniwa łańcucha dostaw: przedstawiciele pracowników operacyjnych firm transportowych, magazynów oraz konsumentów niezwiązanych zawodowo z transportem i magazynowaniem z Polski południowo-wschodniej (dobór próby miał charakter przypadkowy).

Analizę statystyczną wyników wykonano z wykorzystaniem jednoczynnikowej analizy wariancji.

Badania pozwoliły na stwierdzenie wysokiego poziomu znajomości opakowań inteligentnych i ich wskaźników wśród przedstawicieli firm transportowych i magazynów oraz niskiego wśród konsumentów. Zróżnicowane wyniki badań pozwalają domniemywać o ograniczonej możliwości usprawnienia procesów logistycznych poprzez wykorzystanie opakowań inteligentnych.

Introduction

Contemporary market of packagings is characterized by the dynamic development, which results from the growth of number of products demanding packagings and the fact that new technologies which ensure product security and functionality of its packagings, come into being. New technologies enabled the development of so called intelligent packagings. Their main function is to inform a potential purchaser about the quality condition of a wrapped product. The main task of intelligent packagings is to monitor the conditions and inform about the changes which appear in a product from the moment it was wrapped until it is opened.

Controlling the conditions and changes which appear in food is particularly crucial in the logistic processes, mainly during its transport and storage.

Intelligent packagings monitor the inside or/and outside surroundings of a product. They deliver, at the same time, information about the product, which is inside the wrapping. Thanks to this type of packagings, detailed changes of the product quality, during storage, can be defined.

The main tasks of intelligent packagings are monitoring or delivering information about a product, its quality, security or localization during transport, warehousing, sale, and during its usage. Operation of these packagings is connected to the use of interactive indicators, most frequently variegated, enabling the valuation of the quality of a product being wrapped. Indicators appear inside the packaging or on its surface, giving the information about the quality state or the conditions of its storage. (BRODY et. al. 2008, CICHÓN 1996, GILES 1999, KORZENIEWSKI et. al. 2011, LISIŃSKA-KUSNIERZ and UCHEREK 2003, LISIŃSKA-KUSNIERZ and KAWECKA 2012, UCHEREK 2003).

There are some types of indicators on the market. The most popular are the time and temperature indicators (TTI-Time-Temperature Integrators), freshness indicators and the RFID (Radio Frequency Identification) system. The working rule of the TTI is: it changes its qualities under the influence of the temperature which is higher than the quality requested or as a result of a thermal effect, accumulated during the warehousing and transport. The consequence of this change, which is irreversible, is a visual effect, the most frequently expressed by discolouration of a marked space of a label. Freshness indicators immediately inform about the product quality. They directly react to the changes of the atmosphere composition in the inside space of the packagings or to the changes which appear on the surface of the product itself. Their work is usually based on detecting the presence of microorganisms metabolites such as: carbon dioxide, sulphur dioxide, ammonia, amina, hydrogen sulphide, organic acids, ethanol, toxin and enzymes. Electronic and optical detectors, as well as variegated compounds, which are created in the reaction with the substance absorbed from the inside of the packaging, can be used in the in the indicator system of the indicator. RFID means identification of objects with the use of radio waves. The data stored in the tag memory is used in order to achieve the aim. The tags are composed of two main elements: the integrated circuit (chip) and the broadcasting-receiving aerial. The chip includes the memory from which we take the data with the use of the wireless transmission, realized by the aerial. The RFID system enables the observation of the way of the product in the supplies chain and the goods protection from the theft or forgery (KABAJA 2012, KOZAK 2007, MAJEWSKI 2006).

In spite of the fact that the concept of intelligent packagings is relatively new, it brings a lot of advantages in the whole world. Above all it creates a challenge for the wrappings producers who use it to increase the shares on the market. These types of packagings can also influence the improvement of the logistic processes.

The aim of this work is to know the opinion of the chosen participants of the supply chain about the role of intelligent packagings in order to make the course of logistic food processes more efficient.

Methods

The research was done with the use of the questionnaire in the period from January to July 2012, on the territory of one of the south-east Poland's voivodeships. There were 186 respondents – the representatives of operational staff of transport companies (43 people), warehouses (33) and consumers (110). Sampling was accidental. All of the respondent groups answered the

same questions in the survey. The questionnaire included the questions concerning the knowledge about the particular indicators of the intelligent packagings, their usage and their meaning in the communication process in the supplies chain. The results of the survey presented in the elaboration are part of the research conducted on the territory of the whole country.

A variance analysis was performed using an Anova packet of the Statistica softwar. It was used in order to answer the question of whether the results of the answers received were varied depending on the sample. Further null hypothesis was verified F Snedecor test. The null hypothesis is rejected when the calculated value of F was higher than the limit (the accepted level of significance $\alpha = 0.05$), which means that the level of the test meter was significantly varied in the compared groups (SOBCZYK 2007).

Results and Discussion

The survey results have been presented below. They concern the answers of the chosen participants of the supplies chain, i.e. transport companies employees, warehouses employees and the consumers not connected professionally with transport and warehousing.

The first question concerned the respondents' knowledge about the „intelligent packaging” term (Figure 1).

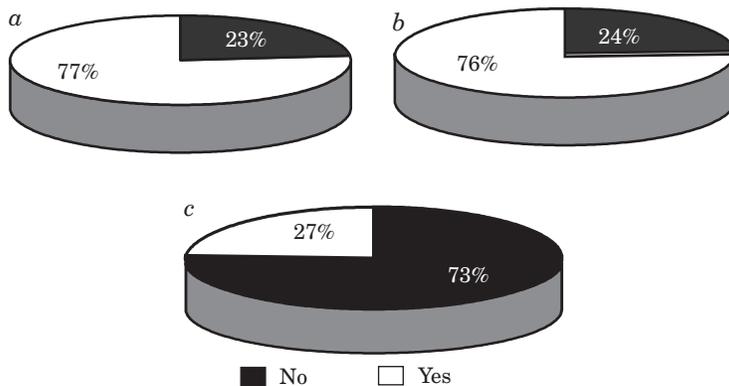


Fig. 1. Knowledge of the term „intelligent packaging”: *a* – the transport companies employees; *b* – the warehouses employees; *c* – consumers

As it results from the above pie charts, the term „intelligent packaging” is the best known by the warehouses employees, slightly worse by the transport companies employees. Consumers, however, hardly know what the term means.

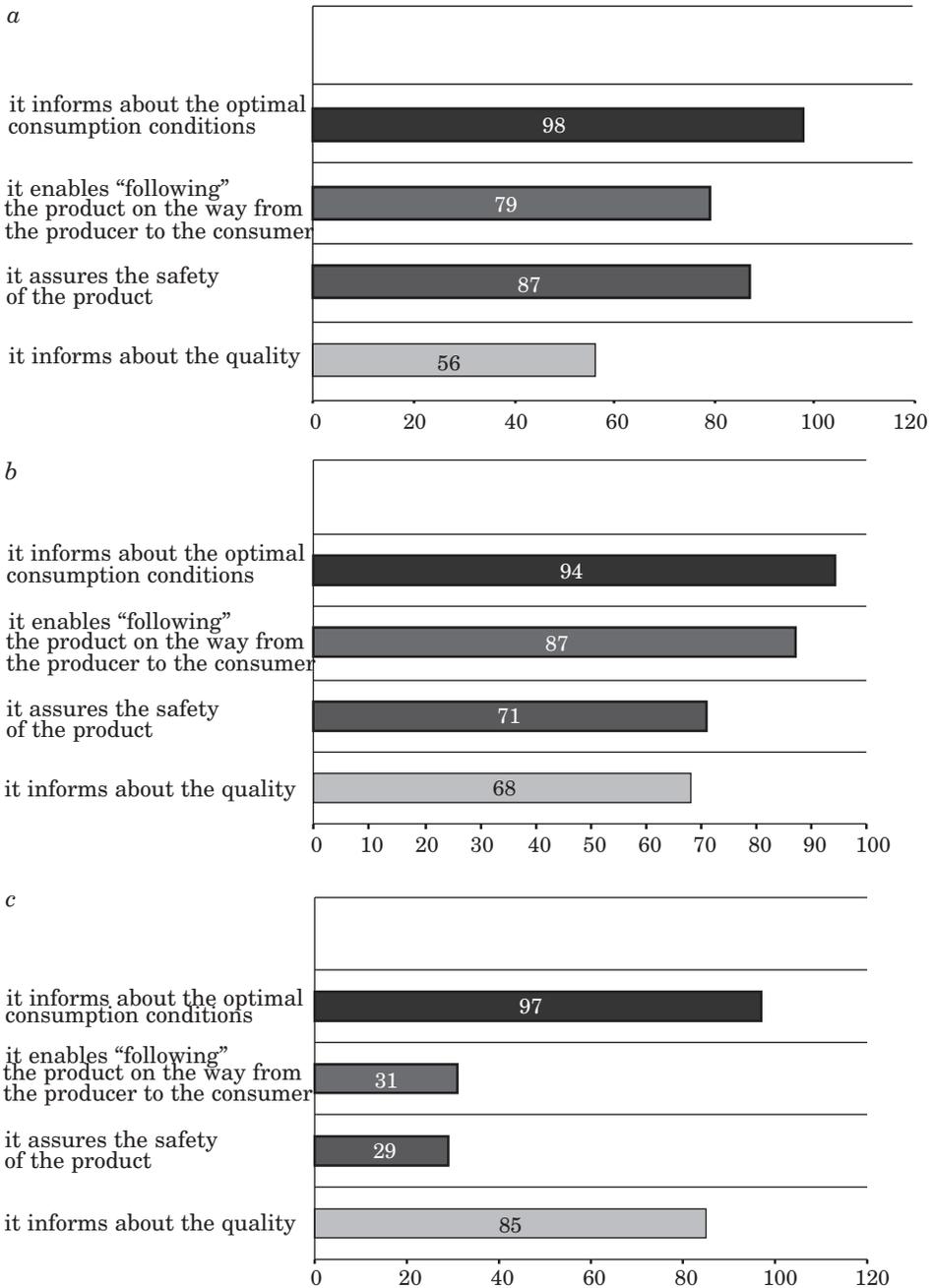


Fig. 2. The opinion on the role of intelligent packaging: *a* – the transport companies employees [%]; *b* – the warehouses employees [%]; *c* – the consumers [%]

As a result of statistical studies stated a statistically significant difference in this regard between the results of consumers answer and employees of stores and transportation companies.

The second question was about the role of the intelligent packagings (common answers were chosen of all the groups questioned) – Figure 2.

The above pie charts indicate that the certain groups of the respondents ascribe the same roles, however, their importance is varied.

The variance analysis allowed us to determine statistically significant difference between the results of employee responses storage and transport company employees and consumers' answer: „it enables following the product on the way from the producer to the consumer” and „it assures the safety of the product”, and no significant difference between the results of other answer of all study groups.

The next question concerned the opinion of the respondents about the place of the intelligent food packagings in order to improve the logistic processes (Figure 3).

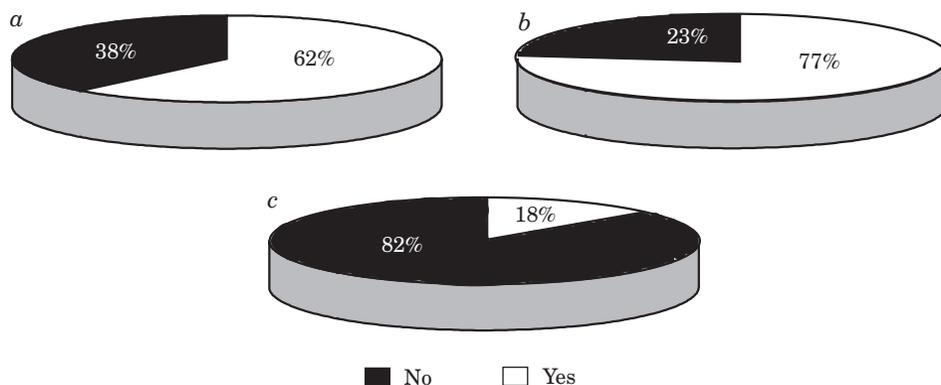


Fig. 3. Opinion on the impact of intelligent food packaging improve the process of movement of goods on the way from the producer to the consumer: *a* – the transport companies employees; *b* – the warehouses employees; *c* – consumers

Contrary to the assumptions, about 30% of employees of the transport companies and warehouses claim that the intelligent packagings do not influence the improvement of the goods transport process, what indicates a low level of awareness in the range of logistic function of the wrappings. A great majority (over 80%) of consumers have a similar opinion.

As a result of statistical research, again found a statistically significant difference (as I have in the case of question 1), in the opinions of consumers and employees of stores and personnel transport companies.

The aim of the next question was to define the influence of the intelligent packagings on the improvement of the logistic processes (Figure 4).

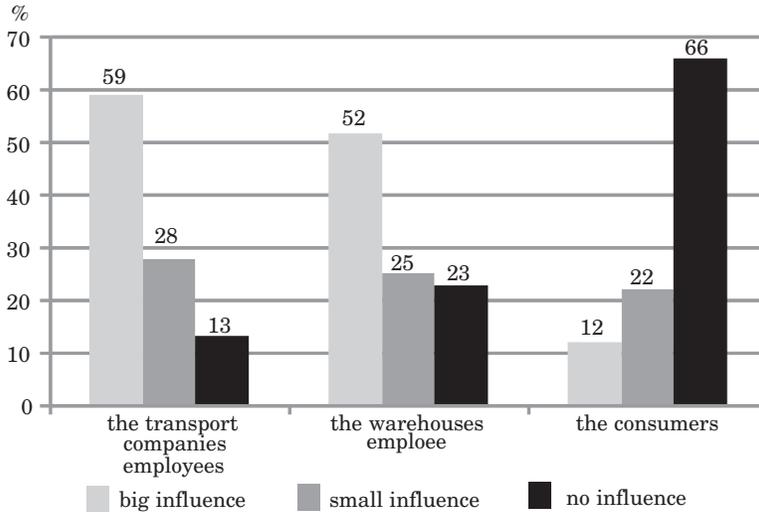


Fig. 4. The significance of the impact of intelligent food packaging process of moving goods on the way from the producer to the consumer

Over the half of the transport companies and warehouses employees indicate a big influence of intelligent packagings on the process of goods transport on the way form the producer to the customer. There are also many respondents in this group who do not see such influence. It is interesting because these employees are everyday participants of the logistic chain. As the results show, however, they are unaware. In the face of the earlier answers, the fact of the lack of awareness of this influence among the consumers is not surprising.

In the context of the impact of intelligent packaging on process of moving goods on the way from the producer to the consumer there was no statistically significant difference between the opinions of consumers and workers warehouses and transport company employees.

The last question concerned the influence of the indicators which are attributes of the intelligent packagings in order to improve the logistic processes (Figure 5). The respondents were presented the list of the chosen indicators (time-temperature; the opening; a quake and inclination; moisture; RFID), with the request of showing, which of them are the most crucial in the context of the logistic processes improvement.

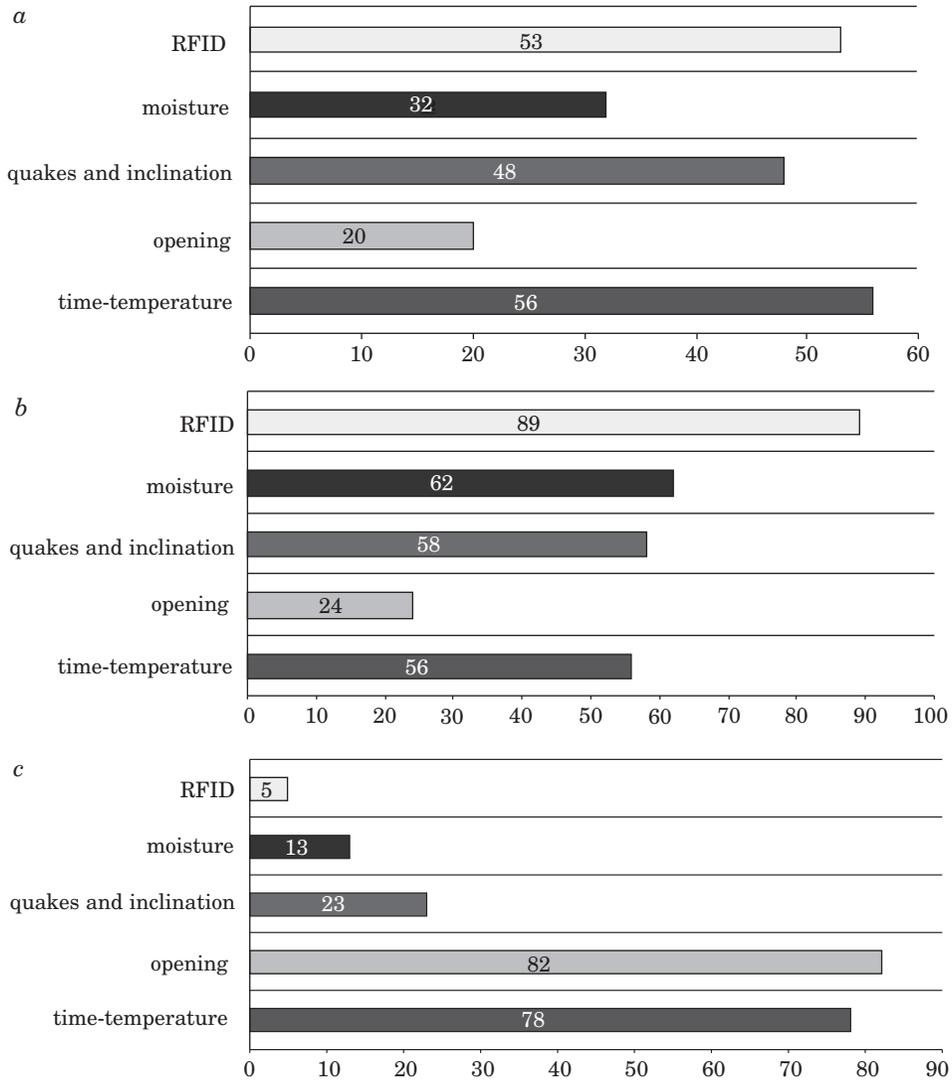


Fig. 5. The significance of the indicators as an attribute in the context of intelligent packaging improvements logistics processes: *a* – the transport companies employees [%]; *b* – the warehouses employees [%]; *c* – the consumers [%]

The results show that the most crucial attributes of the intelligent packagings proved to be: in the group of transport companies and warehouses employees – the time – temperature indicator and RFID, however, in the group of the consumers not professionally connected to transport and warehousing – the indicator of the opening and time – temperature.

As regards the impact indicators which are attributes of smart packaging to improve logistics processes were significantly statistical difference in the results of the answers given to this question between warehouses workers, transport companies workers and consumers.

Conclusions

The questionnaire done and the observations allow to formulate the following conclusions:

1. The knowledge about the term „intelligent packagings” and its role in the improvement of the processes of goods transport is varied, it depends on the logistic link chain.

2. The most aware participants of the logistic chain, in the range of the influence of the intelligent packagings on the process of goods transport on the way from the producer to the consumer proved to be the transport companies employees, the least, however, the consumers, not professionally connected to transport and warehousing.

3. The most crucial attributes of the intelligent packagings proved to be: the time- temperature indicator, RFID and indicator of the opening.

4. A variance analysis allowed us to verify the results of response groups.

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