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Assessment of consumer awareness regarding the implementation of innovative food packaging

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Abstract. Food packaging fulfills many practical functions. They protect against harmful external factors and facilitate transport, distribution on the market, and storage of products in households. They also provide information on food products' type and composition, preparation method, and shelf life. The important role played by packaging contributes to their continuous improvement. An example of this improvement is the implementation of innovative solutions, including active and intelligent packaging. The question remains whether consumers know about these innovative facilities and whether they use them. In search of an answer to this question, a survey was conducted on 210 respondents in the Mazovian region (Poland). The survey aimed to assess consumer knowledge and awareness of active and intelligent food packaging. The study was conducted using the CAWI (Computer-Assisted Web Interview) method. As many as 79% of respondents did not know the term active packaging. It was similar in the case of intelligent packaging - 79% of respondents did not know this type of packaging. Respondents also showed a low level of knowledge regarding the different types of inserts in active packaging and examples of benefits offered by intelligent packaging. The survey results suggest the need to disseminate knowledge and benefits related to active and intelligent packaging.

Key words: active packaging, consumer awareness, intelligent packaging, respondents, survey.

INTRODUCTION

Packaging is one of the key elements of the consumer supply system for food products. This is due to the functions that packaging fulfills. Packaging protects products against harmful external factors. It is an integral part of the food processing chain and helps producers distribute products more efficiently, i.e., transport, storage, and sale, and consumers purchase and use food. Packaging ensures that the product is delivered to the consumer in known quantities and in the expected condition for a specified shelf life. It is a way to make food more attractive, promote its use, and increase sales. Packaging can inform consumers about the type of food being purchased, its preparation, its shelf life, and compliance with relevant food regulations (Robertson, 2012).

In a shop or other point of sale, good packaging, its appearance, and general presentation help attract customers, while functional features can ensure the convenience of using food products. Therefore, food packaging is subject to systematic improvement, becoming an essential link in the sustainable development of the consumer market. Improvements and changes in packaging can bring real benefits to many consumers. These benefits can result from improving the quality of the product sold on the market or increasing the value of the product by improving its appearance and attractiveness to consumers (Stewart, 2007). The attractiveness of a properly designed package can stimulate consumer behaviour when evaluating a product and making purchasing decisions (Becker et al., 2011). Packaging, especially its material, can arouse the consumer's emotional state, which is an important signal identifying acceptance or avoidance of the offered food product (Clark et al., 2021). Many packaging features can influence consumer evaluations of food products. The question is whether these features also include those that identify packaging innovation.

Improvement and innovation are somehow inherent in the development of food packaging. This thesis is confirmed by examples of practical solutions that are gradually appearing in the food packaging space. Such examples are active and intelligent packaging (Barska & Wyrwa, 2016).

The idea of active packaging considers the interaction between the packaging, the product, and the environment. These are systems where the conditions inside the packaging are actively changed to extend the product's durability and maintain the highest possible food quality (Pereira de Abreu et al., 2012).

The idea of intelligent packaging comes down to equipping it with an external or internal indicator that provides information about the history of the packaging, product quality, safety, and location during transport. This type of packaging has an extended information function. Customers have access to up-to-date information about the quality and safety of their food without having to open the packaging (Vanderroost et al., 2014).

Consumers have no problems identifying food packaging (and its features) made of plastic, metal, glass, paper, and cardboard. These types of packaging have been known and widespread for many years. However, are consumers able to identify anything more in food packaging? Are they only interested in fulfilling basic functions through food packaging? Questions formulated in this way may inspire research involving a group of consumers. This research may answer the research problem concerning consumer awareness in improving food product packaging.

The aim of the research study was to assess consumer knowledge and awareness of the active and intelligent packaging of food products available on the market.

The research study tested the following hypothesis: Consumers may have limited awareness of the use of improved food packaging.

Implementing the research study objective and confirming or denying the research hypothesis required designing an appropriate, methodical approach. This approach included preparing a survey questionnaire, selecting a research tool with respondents' participation, conducting a survey on a group of respondents, analyzing and discussing the research results, and formulating conclusions and suggestions.

MATERIALS AND METHODS

Social (human) and marketing research related to knowledge management and consumer decision-making include quantitative and qualitative methods of research studies. In this group of studies, research using a survey questionnaire makes a particularly valuable contribution. This type of research is most suitable for obtaining information about consumers, their preferences, and behaviours on the market, including the food market.

The first stage in the designed research study procedure was formulating questions and proposing a response scheme. These were schemes individually adapted to the specifics of each question. The next stage in the procedure was to conduct a preliminary (pilot) study, consisting of sending surveys to 15 consumers. This stage aimed to check whether respondents had problems understanding the questions and providing answers using the proposed scheme. After analyzing the pilot study results, some survey questions were clarified, and the response format was more precisely adjusted. Then, a large-scale survey was conducted. The large-scale survey was conducted using the Internet. The survey was conducted using the CAWI (Computer-Assisted Web Interview) method, allowing the respondents to provide answers using an online panel. Detailed survey results were initially processed using the Google Forms tool and compiled in an Excel spreadsheet. In the final stage, the spreadsheet data was processed using percentage conversions of responses and figures.

Information about the availability of the survey to be completed was posted on online social media platforms, which made it easier to reach groups of potential respondents interested in participating in the study.

The survey was completely anonymous. Respondents completed the survey individually, independently of other people. They did not know the answers given by other people.

The respondents' opinions on active and intelligent packaging were collected based on six questions. A response scheme was prepared following the way the questions were formulated in the survey. A yes/no response scheme was included for some questions, while for other questions, respondents had several answer options, with the possibility of single or multiple choice.

210 respondents took part in the survey, mainly from the Masovian region (Poland). At the first stage of completing the survey, the respondent was given the option of indicating their age, from the following ranges: 16–18 years, 19–30 years, 31–50 years, and over 50 years. It was assumed that people aged 16–18 may also be active market participants who make purchases and are able to identify different packaging categories. The percentage of participants representing the four age groups was as follows: 16–18 years - 18%, 19–30 years - 65%, 31–50 years - 14%, and over 50 years - 3% of people.

The survey involved 123 women (58.6% of respondents) and 87 men (41.4% of respondents).

At the beginning of the survey, respondents were also asked to provide their education and place of residence (from options for rural areas and cities with different populations). The largest group of respondents had secondary education (49%). The next group was people with higher education (30% of respondents), followed by those with primary education (13%). The fewest consumers had vocational education - 8% of respondents.

Considering the place of residence of the survey participants, the largest group were residents of cities with a population of over 100,000 (38% of respondents). The second largest group was people living in the countryside (village), who comprised 35% of respondents. The group of inhabitants of cities with a population of up to 100,000 was the smallest, accounting for 27% of the respondents.

RESULTS AND DISCUSSION

Results of the survey in the area of active packaging

The question was formulated: Are you familiar with 'active packaging'?

The vast majority, 79% of respondents, were unfamiliar with the term active packaging. Only 21% of respondents knew what active packaging was.

To examine the problem of respondents' knowledge of active packaging in more detail, the survey results were linked to the education of the people filling out the survey. Table 1 presents the results of this comparison.

Table 1. Distribution of responses to the question about knowledge of active packaging for groups of respondents with different education

Respondent's education	Answer option		Relation
	Yes	No	Yes / No
Primary education	1.9%	10.9%	0.17
Vocational education	2.4%	6.2%	0.39
Secondary education	10.0%	39.0%	0.26
Higher education	6.7%	22.9%	0.29
TOTAL	21.0%	79.0%	

Directly comparing the number of responses (percentage of responses) for individual groups with a given education is difficult due to the different numbers of people in each education category. Therefore, the structure of responses was compared based on the percentage of Yes to No responses. The highest ratio of positive responses (Yes) to negative responses (No) was found in the case of the group of respondents with vocational education. On the other hand, this group of respondents was the smallest (8% of the total population of participants), so it isn't easy to draw clear conclusions. It seems more important to draw attention to respondents' generally low knowledge and awareness regarding the active packaging of food products on the market.

Most answers to the question about knowledge of active packaging were 'No'. We can look for justification for this attitude of the survey participants. This result may be caused by the fact that active packaging is not promoted often and sufficiently, and consumer awareness of its existence is low.

Developing a more detailed approach to assessing knowledge about active packaging, the next point in the survey asked: Which of the known types of active packaging are you familiar with? In this question, respondents could choose an answer from eight suggested options. These were seven factors used in active packaging and the eighth option - none of the factors known to the respondent. This question allowed for a maximum of two answers, but could also be one.

The distribution of responses regarding knowledge of active packaging with different types of inserts is presented in Fig. 1. Because respondents could select one or more answers, the sum of percentages does not add up to 100% (Fig. 1).

The distribution of responses in Fig. 1 indicates a relatively low percentage of respondents who confirmed their knowledge of active packaging with the types of inserts distinguished. For the seven types of active packaging included in the survey, on

average, only 13% of respondents were familiar with these packages. Almost five times more, or 64% of respondents, stated that they were unfamiliar with any active packaging with the insert listed in the survey.

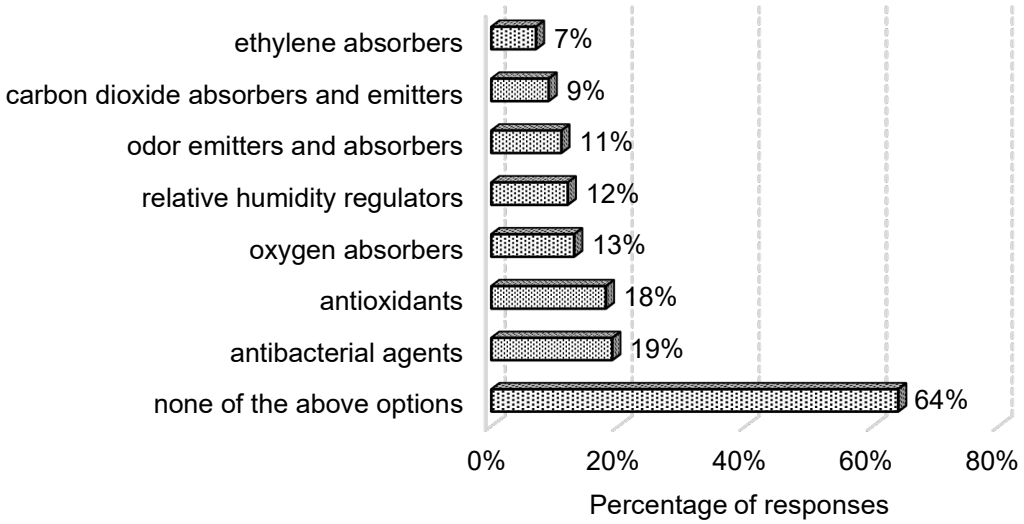

Figure 1. Percentage distribution of responses regarding knowledge of active packaging with different types of inserts.

The high percentage of people unfamiliar with any of the active packaging listed in the survey with the specified insert confirms the results of the answers to the previous question. It concerns the general question: Are you familiar with 'active packaging'? 79% of respondents indicated they were unfamiliar with active packaging.

Results of the survey in the area of intelligent packaging

Respondents were asked whether they were familiar with intelligent packaging in the following survey question. It turned out that the distribution of answers to this question was the same as in the case of active packaging. As many as 79% of respondents did not know what intelligent packaging was, while only 21% of people knew about this packaging.

In more detail, the survey results were analyzed to link respondents' knowledge of intelligent packaging with their place of residence. The results of this comparison are presented in Table 2.

Table 2. Distribution of responses to the question about knowledge of intelligent packaging for groups of respondents with different places of residence

Respondents' place of residence	Answer option		Relation
	Yes	No	Yes / No
Village	8.0%	26.8%	0.30
City up to 100 thousand inhabitants	6.0%	20.7%	0.29
City with more than 100 thousand inhabitants	7.0%	31.5%	0.22
TOTAL	21.0%	79.0%	

Regardless of the respondent's place of residence, in none of the cases did the knowledge of intelligent packaging stand out. For each group of residents, most responses indicate a low understanding of the type of packaging in question. The lowest ratio of responses confirming (yes) to denying (No)

knowledge of intelligent packaging was found in the group of respondents from large cities (with a population exceeding 100,000 inhabitants).

The survey also developed more detailed issues related to intelligent packaging. In the next question, respondents were asked to indicate which examples of intelligent packaging they were familiar with. The survey question listed five types of intelligent packaging (to choose from). The sixth option was: 'I do not know any intelligent packaging listed'. Survey participants could choose no more than two of the options provided. For this reason, the sum of the percentages of the individual responses is different than 100%. The percentages of responses regarding examples of intelligent packaging and knowledge about them among respondents are presented in Fig. 2.

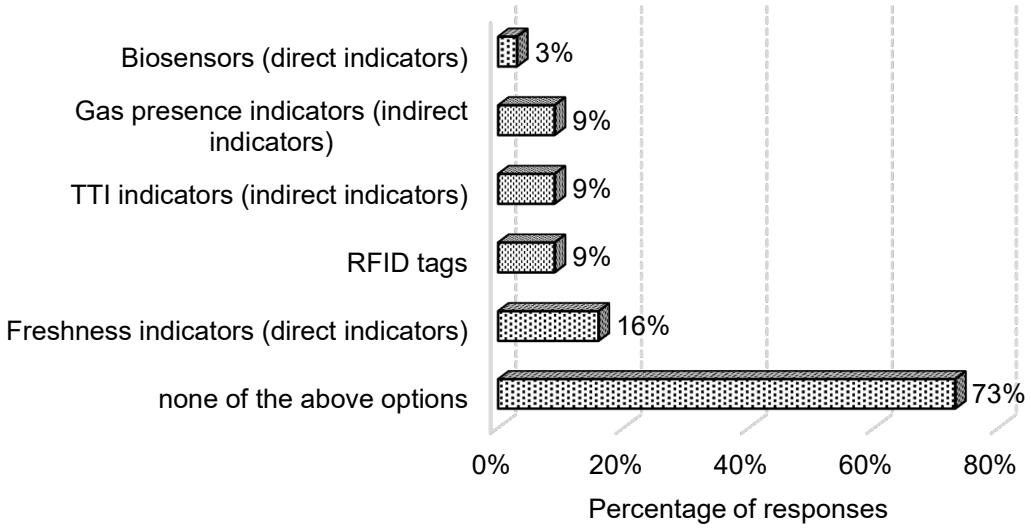

Figure 2. Percentage distribution of responses regarding knowledge of intelligent packaging.

The survey results presented in Fig. 2 indicate respondents have a low level of knowledge regarding sample solutions of intelligent packaging. Knowledge of specific types of intelligent packaging was confirmed by an average of 9% of respondents. Among the five examples of intelligent packaging mentioned, the most well-known was packaging with freshness indicators (confirmed by 16% of respondents), while biosensors were the least well-known (indicated by 3%). However, it is worth noting that compared to the average percentage (9%) of respondents who were familiar with examples of intelligent packaging, the percentage of responses indicating no knowledge of this packaging (73%) was more than eight times higher.

To sum up, the results of this part of the study confirm the research hypothesis that consumers may have limited awareness of the use of improved food packaging.

Other results from the survey on active and intelligent packaging

The next question was to see whether consumers would be more likely to purchase a product when packaged in active or intelligent packaging. This question had three options: yes, no, and I have no opinion.

As many as 79% of respondents chose the option ‘I have no opinion’. This is probably due to limited knowledge of such packaging and its possibilities on the market. Only 17% of respondents indicated that in the case of products packed in such packaging, they are more willing to buy them. Only 4% of respondents considered that access to active and intelligent packaging does not affect their purchases. The results of this part of the survey showed that in the most numerous respondents (19–30 years old), the percentage of people willing to buy products in active or intelligent packaging was 17%. The older age groups had the most people declaring they would buy products in active or intelligent packaging.

The last question in the survey asked about the benefits consumers think are associated with packaging a product in active or intelligent packaging. In this question, respondents had access to six answer options. At least two issues could be selected. The percentage of indications for each option regarding the benefits of packaging food products in active and intelligent packaging is presented in Fig. 3.

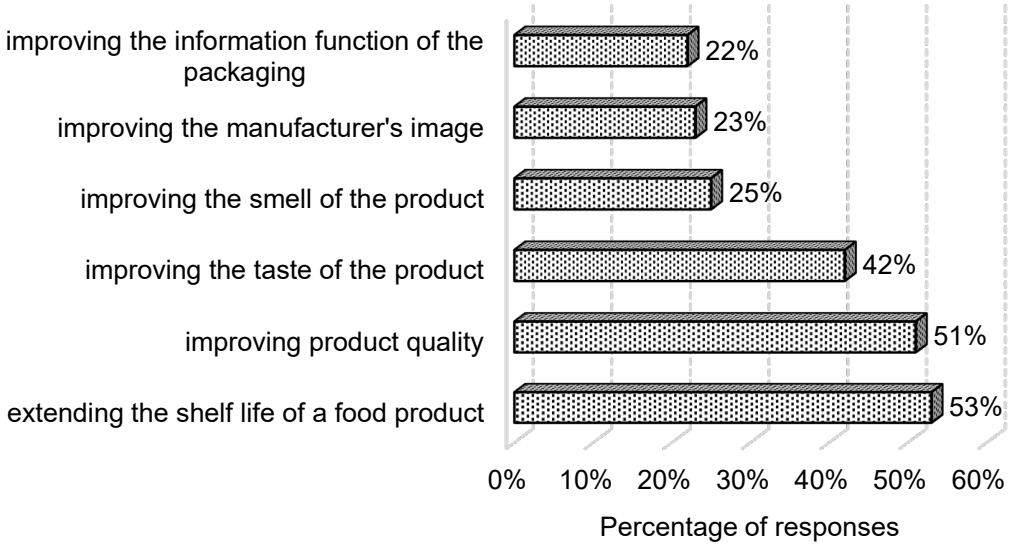

Figure 3. Percentage distribution of responses regarding the benefits of product packaging in active or intelligent packaging.

Despite the limited level of consumer awareness of active and intelligent packaging assumed in the research hypothesis, the question aimed to check what the respondents may associate with these types of packaging. Respondents highlighted (Fig. 3) the importance of factors determining product quality in active or intelligent packaging. Most respondents answered that the key benefits associated with active and intelligent packaging are extending the shelf life of the food product (53% of respondents) and improving the product quality (51% of respondents). In the question under consideration, 42% of respondents highlighted the importance of improving the product's taste using active and intelligent packaging. This result is worth comparing with the next factor (in terms of percentage indication) that respondents emphasized. This factor is the product's smell, which was indicated by 25% of respondents. Does such a comparison indicate that the product's taste is more important to consumers than its smell? It is worth

answering these and other questions when discussing the survey results and in the broader context of food product packaging and its assessment.

The evaluation of food packaging can be carried out in different ways, depending on the purpose of the evaluation. Of course, assessing packaging properties in terms of their safety of use in contact with food products (Karmaus et al., 2018) and functionality (Grönman et al., 2013) plays a key role. However, consumer opinions on packaging are also important because they are the recipients of food products. The discussion could address the question: what is the basis for consumers forming opinions about packaging? Is it only the material from which the packaging is made, its attractiveness in terms of appearance, and the information part on the packaging? Many features of food packaging, including its design, size, shape, colours, fonts, etc., can influence the market attractiveness of the product and the consumer decision-making process (Malešević & Stančić, 2021). Consumers' decision-making style interacts with product attractiveness (Soler-Anguiano et al., 2023). When deciding to purchase a food product, the consumer may be guided by the attractiveness of the product packaging (Borishade et al., 2015). Are the characteristics of active and intelligent packaging also responsible for this attractiveness? Our survey results indicated a relatively low level of awareness of respondents regarding active and intelligent packaging. This would suggest that knowledge about active and intelligent packaging rather than the attractiveness of its features could have determined the results of the answers given by the respondents. In the case of active and intelligent packaging, 64% and 73% of respondents, respectively, indicated that they were not familiar with the sample packaging options under consideration.

Is respondents' relatively low knowledge about active and intelligent packaging a surprise? The presented results of our own research reflect the opinions of respondents from the Mazowieckie region in Poland. Research also conducted in Poland, but in the Lubuskie region, showed that the term 'intelligent packaging' was known by 17% of respondents (Barska & Wyrwa, 2016). In the same study, the term 'active packaging' was known by only 4% of respondents. Consumers can come across various packaging representing active and intelligent solutions every day. But how often are consumers unaware they are in contact with practical examples of active and intelligent packaging?

Research on active and intelligent packaging, its improvement, implementation of new projects, and the recognition of this packaging by consumers was undertaken many years ago (Vanderroost et al., 2014). The question remains: To what extent does the development of active and intelligent packaging change consumers' awareness of and knowledge of this packaging? Changes in this consumer awareness are worth systematic research. If the newly created generations of active and intelligent packaging are to be the future of food packaging (Aday & Yener, 2015; Ghaani et al., 2016), then consumers should follow this trend. However, it is important, as indicated by the research of Loucanova et al. (2017), that among consumers, it is possible to identify target groups that are particularly interested in the types of packaging under consideration. As the age of the target group increases, customers are more oriented towards active packaging functions. On the other hand, consumers of decreasing age may be more inclined towards intelligent packaging functions (Loucanova et al., 2017).

Using research methodology involves recognizing various aspects of consumer knowledge and identifying the features of food products, their packaging, and other evaluation elements. The presented research study used a survey method, standard in

collecting respondents' opinions. However, the details regarding how questions are formulated, the options for providing answers, and the development of the survey results are crucial. The proposed method of evaluating respondents' answers uses the Kano model, which divides the analyzed packaging functions into mandatory, attractive, neutral, and reverse categories (Loucanova et al., 2017). In evaluating selected food packaging features, a point scale (for example, from 1 to 5) is also considered, which allows us to examine the distribution of point values. The point scale was used to propose a feature significance index - FSI (Gaworski et al., 2021), allowing for a comparison of the examined packaging features in the respondents' assessment. An extension of this approach using respondents' responses on a scale from 1 to 5 is the barrier significance index - BSI (Lamm et al., 2023), which also takes into account the ratio of the percentage of agree and strongly agree ratings (4 and 5) to the percentage of strongly disagree and disagree ratings (1 and 2).

In our survey, a wide age range of respondents was considered. This requires an appropriate approach to interpreting the research study's results considering age groups. Analyzing the survey results through the criterion of age groups makes a valuable contribution to assessing the diversity of preferences and behaviour of respondents (consumers) of different ages in the considered research area (Baruk & Iwanicka, 2016). In opinion surveys, it seems equally essential - due to the comparison of results - to consider other criteria characterizing respondents. Such a criterion may be not only education but, in the case of higher education, also the type of studies completed (Gaworski & Turbakiewicz, 2020). In survey research, it may be crucial to identify the main stakeholder groups clearly. This reasonable approach to many survey studies allows for the collection of reliable research material, its discussion, and the formulation of valuable observations (Johnson et al., 2025).

The respondents in this study came from different places of residence, which did not translate into differentiation of the results regarding knowledge about active and intelligent packaging. However, this does not mean that place of residence cannot be an essential criterion for comparison in survey studies. Suppose the aim of the study is, for example, to compare the knowledge of respondents and their access to certain food products. In that case, the region of residence of the respondents may be a key criterion for comparison (Kamińska et al., 2016). Another example is comparing the impact of food packaging on the buying behaviour of rural and urban consumers (Sehrawet & Kundu, 2007); rural consumers were more critical of packaging, believing that it could mislead buyers and cause environmental hazards.

The consumer awareness problem of active and intelligent packaging addressed in the survey is an example of research on contemporary problems in the consumer market. These contemporary problems in the case of packaging have a much broader dimension and raise the issue of consumer response to environmentally friendly food packaging (Ketelsen et al., 2020), biodegradable packaging (Bojanowska & Sulimierska, 2023), packaging recycling (Ruokamo et al., 2022), the connection between packaging and food waste (Williams et al., 2020) and others.

Consumer knowledge about the current problems of food packaging development should be part of the transformation of the food chain (Gaworski, 2006), where the implementation of sustainable packaging should play a key role (Boz et al., 2020).

Food product packaging should focus the attention of all market participants, consumers, and food producers. Therefore, it is essential to develop research that considers brand owners and their approach to implementing modern and improved food packaging. In this case, the issue of brand owners' awareness of introducing food products in active and intelligent packaging to the market and their acceptance and popularization can be raised (Klimchuk & Krasovec, 2013). Attractive graphic designs of packaging proposed by brand owners can play a special role in disseminating and promoting knowledge about active and intelligent packaging (Wells et al., 2007; Wu, 2015). The flow of information - via food packaging - between brand owners and consumers could be an area for further research studies. These studies can make a valuable contribution to the sustainable development of the food market.

CONCLUSIONS

Many active and intelligent packaging features are not sufficiently recognized by consumers, as confirmed by research on a group of respondents in the Masovian region of Poland.

The survey results suggest the need to disseminate knowledge about active and intelligent packaging specifics. The source of dissemination of knowledge about the groups of packaging under consideration may be programs and other forms of knowledge transfer in the mass media.

The presentation of the benefits of using active and intelligent packaging may inspire increasing interest in this type of packaging among consumers.

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