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Assessing packaging-related knowledge on the basis of a quantitative study

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1. SUMMARY

Packaging technology is one of today's rapidly evolving disciplines, with innovative implications for many other disciplines, such as the food industry. Plastics can also be referred to as the materials of the 21st century, without which we could hardly imagine our lives today. Bioplastics are made from raw materials from renewable sources, while degradable plastics are mixtures of plastics made from conventional raw materials and additives that aid degradation. In my qualitative, online study, 513 people answered my questions about what the main function of packaging is, what characteristics a packaging material should possess, foods in which packaging are preferred, whether they had ever encountered environmentally friendly packaging materials. In addition to a lot of useful information, it turned out that Hungarian people are typically eco-conscious on paper, but in reality they do not pay enough attention to it. It is primarily college graduate women between the ages of 46 and 65 who also take environmental and ecological considerations into account when buying food.

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2. Introduction

Packaging technology research is one of today's rapidly evolving disciplines, with innovative implications for many other disciplines, such as the food industry. The advent of plastic packaging materials has opened up new perspectives in improving the shelf life of foods. The history of plastics goes back only 155 years, while the use of bioplastics has a history of only a few decades. Nevertheless, application of the latter has been increasing in recent times at a rate which is significantly higher rate than that of conventional plastics.

In recent years, there has been a significant increase in interest in natural polymers on the part of both industry and academia, which is presumably related to the difficulties in the field of waste management and the relevant regulation. A further incentive for the development of bioplastics may be the declining amount of fossil raw materials available for the industry.

2.1. Aim of the study

In my study, I sought to answer the following questions:

- What do consumers think about packaging in general?
- How do they see the need to package food products?
- Do they know environmentally friendly packaging materials?
- Are the properties of the packaging material taken into account when purchasing?
- What characteristics are considered important when choosing packaging material?

3. Literature review

3.1. Position, definition and properties of plastics

Plastics are macromolecules composed of monomers that are made artificially, entirely or in part **[1]**. Polymers (from the Greek, meaning many parts) are mainly composed of eight chemical elements: C, H, O, N, Cl, F, S, Si. These atoms are linked to each other by covalent bonds to form molecules. The small molecules used in polymer production are traditionally produced from petroleum. Today, significant research is being conducted to be able to produce these from renewable raw materials **[2]**.

Plastics can also be referred to as the materials of the 21st century, without which we could hardly imagine our lives today. On the one hand, artificial polymers can be produced economically and, on the other hand, they allow technical solutions that would not otherwise be possible **[3]**. The impact of plastics and plastic packaging materials on our environment is the subject of an extensive debate among both professional and lay communities.

Campaigns in recent years have been directed primarily against the use of plastics, although in practice, the use of only a relatively small proportion of them, plastics used for packaging may be responsible for damage to the environment. The plastic waste pollution of the environment is mainly due to the fact that plastic packaging materials can be produced relatively cheaply, they are not of great value after use, so unfortunately they end up as not recycled waste, even if this is not justified **[4].**

3.2. Plastic packaging and food packaging

Foods are biologically sensitive substances. Their original freshness and shelf life depend on the intrinsic properties of the product and on external conditions. Intrinsic properties are the microbiological state of the food, its composition, water activity and pH. External conditions include processing hygiene, the optimum gas or gas mixture, the packaging machine, the packaging material, and the temperature during processing and storage **[5]**.

The most significant plastic packaging material type is polyethylene. The different polyethylene types are members of the simplest synthetic polymer family produced in the largest amount, polyolefins. The most common types of plastics are polyethylene (*01 - PET*), high density polyethylene (*02 - HDPE*), polyvinyl chloride (*03 - PVC*), low density polyethylene (*04 - LDPE*), polypropylene (*05 – PP*) and polystyrene (*06 - PS*). In parentheses are the conventional codes and abbreviations of the different plastics. The code for other plastics no listed here is *07* **[6]**.

3.3. Bioplastics

Bioplastics are made from raw materials from renewable sources, while degradable plastics are mixtures of plastics made from conventional raw materials and additives that aid degradation. The best known bioplastics discovered in the 20th century are starch-based ones, polylactic acid, poly(hydroxyalkanoate) and polybutylene succinate adipate, and their use has been increasing significantly in recent years.

Life cycle analyses have shown that, compared to conventional plastics, the use of bioplastics can reduce greenhouse gas emissions by 30 to 50% annually **[7]**.

3.4. Consumer behavior, trends

By the concept of *consumer behavior* we mean the processes and activities that are aimed at obtaining, using and evaluating a given product. In its examination, a significant distinction should be made according to the product group to which the goods to be acquired belong, the so-called nondurable or durable consumer goods **[8]**.

Factors influencing consumer behavior can be grouped as follows **[9]**:

Cultural factors
- Culture
- Subculture
- Social classes

Social factors
- Reference group
- Family
- Social statuses

Personal factors
- Age, family, life cycle
- Occupation
- Economic conditions
- Lifestyle
- Personality

Psychological factors
- Motivation
- Perception
- Learning
- Beliefs, attitudes

According to the introductory text of the website of Dr. Törőcsik Kft., „The trend is the intensification and spread in society of certain phenomena and processes taking place in the market, which has a significant impact on the behavior and habits of consumers in the foreseeable future" **[10]**.

Among the trends of 2019, environmental awareness has emerged, manifesting itself in *Plastic Free July* and *Straw Free August*.

Plastic Free July started in Australia back in 2011 and has since spread around the world. In Hungary, it was first announced in 2018, but became well-known only in 2019 **[11]**.

Hungarian environmental organizations have also embarked on an active campaign, as an image of a turtle drowning because of a plastic straw posted on the internet has made the public realize that animals see plastic waste thrown away by many people as food **[12]**.

4. Materials and methods

In order to achieve the research goal, both secondary and primary information collection were carried out.

During the secondary research, to form the basis for my primary research work, the available Hungarian and international surveys conducted earlier and related to the topic were reviewed.

In the primary data collection, of the marketing research methods, the quantitative procedure was chosen, more specifically the questionnaire survey. In this type of research, due to the large sample size, it is essential to use mathematical-statistical methods, and the results of the research are reported in a quantified way, taking into account the requirement system for statistical reliability tests **[13]**.

The questionnaire was prepared in July 2020, and it was completed through an electronic platform. Online completion was chosen because, over the last en years, online quantitative research has become one of the most important data collection channels for market research. Both researchers and their clients are now convinced that online research not only offers more in terms of speed and cost-effectiveness than personal or telephone data collection, but the reliability and authenticity of the data are also unquestionable **[14]**.

The questionnaire can be divided into two main parts:

1. Packaging knowledge, opinions, habits related to food products;
2. Demographic questions (gender, age, education, economic status).

The questionnaire was completed by the respondents between July 20 and 31, 2020.

For the completion, the following two methods were used:

1. Quota sampling, in which the population was divided into subgroups (based on age groups), and the elements were selected from these; followed by the
2. Snowball method, which means that the individuals selected previously were asked to forward the link to the questionnaire to people they know who belong to a similar age group.

When designing the research, the goal was to reach 500 people. This goal was slightly exceeded, so the final size of the sample was 513 people.

When processing the data, the program TIBCO Statistica™ Trial Download for Windows Version 13.5.0.17 was used. In most cases, the results obtained were rounded to 2 decimal places, according to the rules of rounding. Where this method was not used (e.g., standard deviation), it is indicated in the paper.

During the evaluation, frequency was examined, cross-tabulation analyses were performed, and descriptive statistical analysis was carried out. Figures were prepared using the 2021 version of Microsoft Excel.

5. Results and evaluation

Basic demographic characteristics of the persons completing the questionnaires are summarized in ***Table 1***.

Table 1. Number and distribution of research participants based on demographic data (N=513)

Demographic characteristics	Number	%
Gender		
Woman	298	58.09
Man	215	41.91
Age groups		
18-25	86	16.76
26-45	219	42.69
46-65	161	31.38
Over 65	47	9.16

In addition, education and economic status were also examined. 67% had college degrees and 29% had high school diplomas. Approximately 60% of the respondents considered themselves and their family to be in an average economic situation, while roughly 30% classified themselves as having a situation more favorable than average.

Question 1 of the questionnaire was in fact a task. Respondents were asked to describe what comes to mind when they hear the word *packaging*. About 16% of questionnaire respondents mentioned the word *plastic*, while only 14% first thought of the term *protection*. In addition to these two major categories, *marketing, paper, waste* and *garbage* were also mentioned.

Question 2 concerned the opinion on the viability of food packaging. Statements were listed and respondents had to decide how much they agreed with them. During the evaluation, the arithmetic mean was calculated, and the statements are arranged in ***Table 2*** in the order of their decreasing value. Means were rounded to 2 decimal places, while the standard deviation was left with the decimal places calculated by the Statistica program.

Table 2. Extent of agreement with statements concerning the viability of packaging, and other related statistical indicators (N=513)

Statement no.	Statement	Arithmetical mean	Median	Modus	Modus frequency (persons)	Standard deviation
1	Protects the product from external damage, contamination	4.68	5	5	413	0.754636
2	Appropriate information can be placed on the packaging regarding the product (e.g., composition, shelf life)	4.12	5	5	267	1.100201
3	Protects the consumer from contact with the product (will not get dirty from it)	3.64	4	5	202	1.397545
4	Makes the product more expensive to sell	2.70	3	1	139	1.402682

The statements, based on the arithmetic mean showing the agreement, remained in the order they were in the questionnaire. Respondents associated the role of packaging with protection. This is in agreement with the outcome of the association task. These values are well indicated by the median, while the modus decreased from 5 to 1 at the last statement. The degree of the standard deviation changes inversely with the value of the arithmetic mean of the agreement: the average degree of agreement decreases, while the degree of deviation from the mean increases.

In **Question 3**, the answer was sought whether the research participant had already encountered foods with biodegradable packaging. The answers of the questionnaire respondents are illustrated in ***Figure 1***.

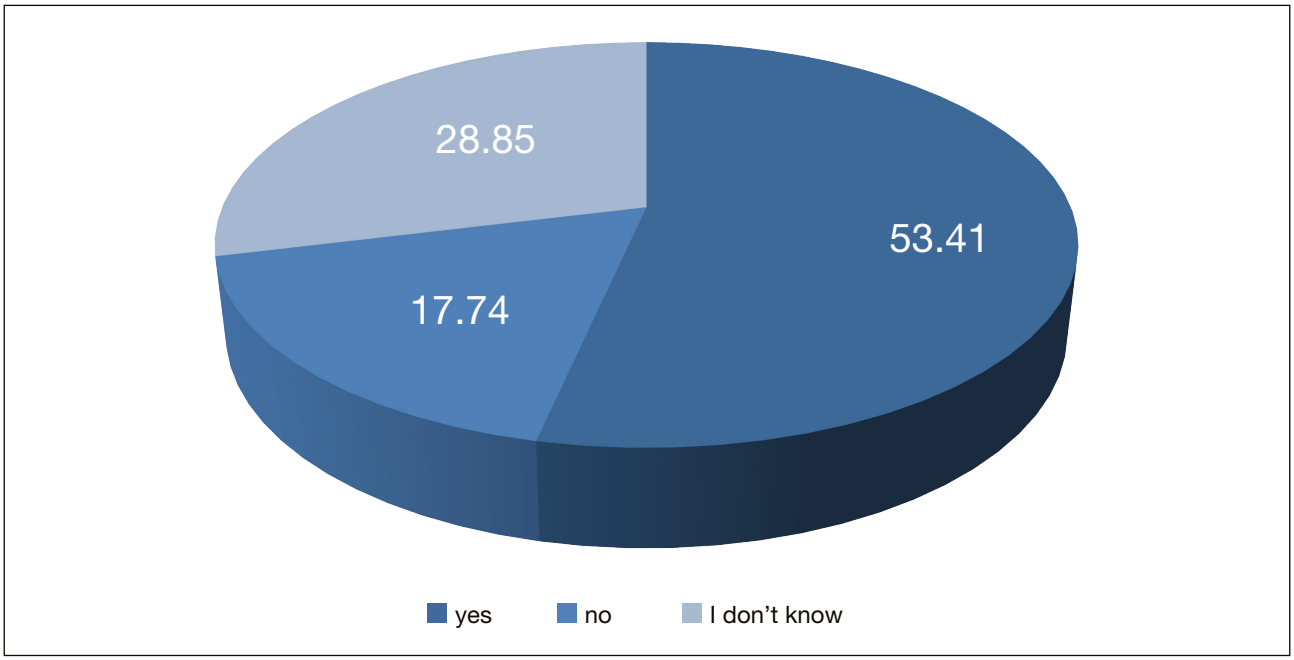

Figure 1. Distribution of respondents based on their answers to Question 3 (%, N=513)

Based on this, it was found that more than half of the respondents had already encountered this type of packaging, approximately one-fifth had not, while roughly ⅓ of them admitted that they did not know whether or not they had encountered degradable packaging.

Examining the responses in view of demographic variables, the following results were obtained (***Table 3***).

Table 3. Distribution of research participants in view of their answers to Question 3, based on demographic criteria (%, N=513)

Category	Criterion	Answers	
		Yes	No
Gender	Woman	50.67	20.13
	Man	**57.20**	14.43
Age group	18-25	**55.81**	15.11
	26-45	**54.79**	17.35
	46-65	49.06	20.49
	Over 65	**57.44**	14.83
Education	Grade school	42.86	14.24
	High school	46.71	16.44
	College	**56.77**	18.44
Economic status	Below average	**55.26**	18.42
	Average	**53.67**	18.34
	Above average	**56.79**	16.57

Remark: Within each category, high values are highlighted in red and bold. The sample number in the age group over 65 is low, so their answers are indicated, but the data were not taken into account in the calculations.

Based on the statistical analysis, it was found that among the subjects interviewed by me, biodegradable packaging had been encountered primarily by individuals meeting the following criteria:

- Men;
- Aged 18 to 45;
- With a college degree

While those who have not encountered such packaging are typically:

- Women;
- Aged 46 to 65;
- With a college degree

Although higher education is included in both categories, this is not a contradiction, because the other two groups in terms of education are present in high proportions at the statement *Don't know*.

However, answers to **Question 4** paint a somewhat more nuanced picture. I tried to eliminate „non-truth tellers". The question was whether the person in question had a habit of inspecting the food packaging at the time of purchase. Overall, ¾ of the respondents do not examine the food product for the type of packaging, and only ¼ do so occasionally or in all cases.

According to my calculations, only 28.8% of those who answered *yes* to Question 4 said that they usually inspect the type of packaging in the case of foods, and only 5.84% claimed that they always do so. In contrast, 64.96% usually do not or never do so.

It has been proven that the Hungarian population is very eco-conscious and environmentally friendly in theory, but they are not necessarily so in reality.

In the case of **Question 5**, respondents were further asked what packaging materials they chose most often when buying food. The frequency distribution is shown in ***Figure 2***.

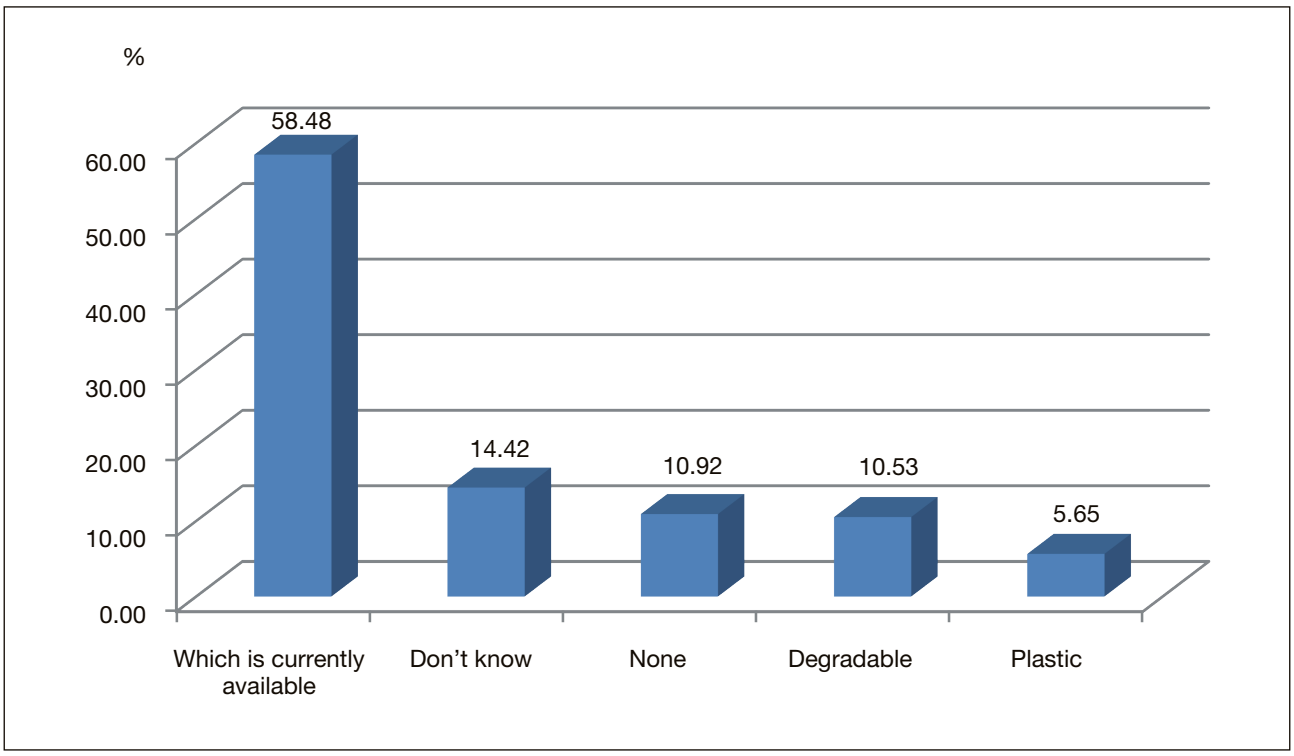

Figure 2. Distribution of research participants based on their answer to Question 5 (%, N=513)

My previous statement can be supported by the figure, according to which the majority of customers (about 75%) do not check the packaging of the product. This 75% is the sum of those answering *Don't know* and *What is available*. This ratio is the same as the value calculated above. The term *Nothing* means the following: *Nothing, I take packaging with me*.

Roughly 10% of the subjects interviewed said they chose products with degradable packaging. Their main demographic characteristics are summarized in ***Table 4***.

Table 4. Main demographic characteristics of those choosing foods with degradable packaging (%, N=513)

Category	Criterion	Proportion of those choosing degradable packaging (%)
Gender	*Woman*	11.07
	Man	9.76
Age group	*18-25*	8.13
	26-45	8.,21
	46-65	11.80
	Over 65	21.27
Education	*Grade school*	21.42
	High school	8.53
	College	10.95
Economic status	*Below average*	7.89
	Average	13.00
	Above average	6.85

Based on the results, those people who actually buy food in degradable packaging belong to the following main demographic groups:

- Women;
- Aged 46 to 65;
- With a college degree;
- With average income

With **Question 6**, the answer was sought what kind of packaging consumers preferred for different types of food. Various product groups were listed, including the meat products to be examined later. Three possibilities were offered to choose from:

- Pre-packaged product;
- Unpackaged goods or goods from the counter;
- I do not usually buy such product

While almost all respondents (93.37%) choose unpackaged goods in the case of fruits and vegetables, the proportion is only about 78.00% in the case of bakery products. The cause for this may be that the increasingly popular specialty bakery products (diet, high-fiber, seeded, etc.) are often sold in a pre-packaged form. In the cases of cheeses and dairy products, the proportion of those choosing pre-packaged products is exceptionally high (75.83%). In the case of meat products, the groups of those choosing pre-packaged and nonpackaged goods are more evenly distributed. The proportions are 47.00% and 46.00% in the case of sliced goods, while they are 41.00% and 49.00% in the case of dry goods sold in the forms of bars, respectively. It is worth noting that, compared to the other product groups, the proportions of those answering *I do not usually buy such products* are the highest in these two cases (roughly 7% and 10%).

Question 7 again was a scale question. Respondents were asked to indicate the importance of packaging material characteristics listed in the questionnaire on a scale of 1 to 5 already used. The following characteristics had to be assessed:

- Quality;
- Thickness;
- Transparency;
- Environmentally friendly nature;
- Recyclability;
- Degradable nature

Table 5. Average and other statistical indicators showing the importance of packaging parameters (N=513)

Parameter	Arithmetical mean	Median	Modus	Modus frequency (pc)	Standard deviation
Quality	4.46	5	5	336	0.892056
Environmentally friendly	4.16	5	5	267	1.065734
Recyclable	4.05	4	5	243	1.118802
Degradable	3.91	4	5	229	1.215985
Thickness	3.75	4	5	186	1.230356
Transparency	3.30	3	5	144	1.422861

From the analysis (***Table 5***) it can be concluded that the most important parameter according to the respondents is quality, followed by environmental friendliness and recyclability. Each of these received an average value above 4.00. Respondents therefore consider environmental protection to be important.

6. Conclusions

Based on my research, the following were found:

- Most of the respondents associated the word packaging with plastics, and this was followed by the term “protection”.
- Participants in the research agreed with the following statement to the greatest extent regarding the purpose of packaging: *We protect the product from external damage and contamination*.
- ¾ of the respondents do not inspect food products with respect to the type of packaging, and only ¼ do so occasionally or always.
- It has been proven that the Hungarian population is very eco-conscious and environmentally friendly in theory, but not necessarily in practice.
- People who actually buy foods in degradable packaging can be characterized by the following major demographic data:
  - Women;
  - Aged 46 to 65;
  - With a college degree;
  - With an average income.

7. Acknowledgment

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