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Consumer acceptance of food nanotechnology

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1. SUMMARY

Today, food industry developments are driven by two megatrends: global warming and the need to address nutrition-related adverse health consequences (diseases of civilization, obesity, hunger and an aging society). As a result, consumer preferences have also changed, as „everyday" needs such as the acceptable price, pleasant taste and safe consumption of foods, as well as for the food to satisfy physiological needs, have become essential requirements and do not represent a demonstrable market advantage. The market presence of a product is expected to be successful if, in addition to the above, its ingredients and physiological effects can be demonstrated to improve or increase consumer well-being, their state of health or physical performance.

One of the fastest growing disciplines today is nanotechnology, which has many applications in the food industry. Even though this technology brings unprecedented benefits to consumers and may be able to solve many global problems, nanofoods also carry many risks and dangers. Although nanotechnology is still unknown to many, the willingness to buy is very high among those interviewed if the technology improves some of the properties of the food. Based on their attitudes, consumers can be divided into two well-distinguishable groups: those who see potential advantages and disadvantages in radically different ways.

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2. Introduction – nanotechnology

One of the most dynamically developing disciplines today is the research of nanoscale materials. Research and application of nanotechnology is one of the great scientific, developmental and technical challenges of the 21st century.

Nanotechnology means the production, of materials, devices and systems that use artificially formed nanoparticles, i.e., particles of material that do not exceed 100 nanometers in size **[1]**. Nanostructured materials are also found in nature (e.g., clays, zeolites), but can be produced artificially as well.

Many nanotechnological applications are known in practice. Examples include highly resistant materials used in construction; lightweight, elastic clothing and sports equipment made of materials resistant to physical stress; self-cleaning paints that protect buildings from, for example, the harmful effects of smog and other contaminants; nanosensors that enable efficient and economical quality control in the food industry; highly miniaturized electronic devices; antibacterial coatings for industrial equipment and household appliances; selective release and high bioavailability drugs; innovative tools for the remediation of contaminated soils and waters. However, in addition to the benefits, nanotechnology poses risks to the environment and human health that are difficult to assess. Scientific research, while still proving to be scarce, suggests that nanoparticles are more reactive and mobile than larger particles and can therefore be toxic to humans and the environment. Little is known about the fate of nanoparticles in the environment. In the human body, nanoparticles may be able to cross the cell membrane and reach internal organs. Some studies have shown that many types of nanoparticles cause greater oxidative stress at the cellular level, increasing the risk of degenerative diseases **[1]**.

2.1. Nanotechnology in the food industry

Due to their special properties, the use of nanostructured materials can also be promising in many food applications **[2].**

Foods containing nanoparticles should be considered as novel foods under Regulation (EC) No 258/97, as foods or food ingredients produced by such technology were not consumed in significant quantities in the European Union before May 15, 1997; thus, their placing on the market is preceded by an authorization procedure accompanied by a rigorous safety assessment **[2]**. As part of the authorization process, EU regulation has recently required food ingredients derived from the use of nanotechnologies to undergo a safety assessment before they can be placed on the market, and only then can they be authorized **[3]**. Related to this, the term nanofood has emerged to refer to foods that are produced, processed or packaged using a nanotechnology technique or device, or to which a nanomaterial is added and/or is enriched with a nanomaterial **[4]**.

Nanotechnologies aimed at improving food quality or safety can theoretically be diverse, but their practical application is still in its infancy. Since food nanotechnology is also a new field for food science, nanotechnology is also a major challenge for the food economy, including food security and safety, traceability, certain areas of food processing and packaging, some new opportunities for nutrient intake, longer food shelf life and many other aspects of consumer protection, from agricultural production to the consumers' tables **[2]**.

The use of nanoparticles in food processing can contribute to the improvement of nutritional quality, taste, color and stability or to increasing shelf life and, in the case of liquid foods, to the improvement of flow properties. An additional benefit of nanotechnology may be that it can contribute to the development of foods with lower fat, sugar and salt content, thereby reducing the incidence of food-related diseases **[5]**.

Currently, these products are available in four categories:

- nanostructured food ingredients and substances, such as nano-titanium dioxide, which is used as an anti-caking agent or pigment;
- nanostructured delivery systems that improve the bioavailability of bioactive compounds in fortified foods and supplements;
- novel packaging materials designed to strengthen the protective function of the product;
- and the use of food contact materials for food processing and storage, such as nano-silver, which is used for its antimicrobial properties **[6, 7, 8, 9]**.

Nanotechnology is currently considered to be the most widespread among food industrial commercial applications in the packaging process **[2, 10]**. Several types of use of nanomaterials in packaging materials can be distinguished. In the case of nanocomposites, advantageous properties (mechanical or functional, e.g., gastightness, temperature / humidity stability) are achieved by adding nanoparticles to the plastic.

A similar effect can be achieved with nanocoatings applied to the surface of the packaging material. Aluminum coatings applied with the help of vacuum are now widespread mainly in the packaging of snacks, confectionery and coffee. For example, if the thickness of the aluminum layer applied as a coating does not exceed 50 nm, the coating metal can be considered a nanomaterial **[11]**. In addition to the above, there are several applications that are still in the research phase **[12, 13, 14, 15]**, such as newly developed food packaging capable of detecting the presence of pathogens and contaminants.

Although this technology offers consumers unprecedented benefits such as higher added value, longer shelf life and increased food safety, nanofoods also pose health, environmental, economic, social and political risks **[16, 17]**. According to Berekaa, despite the huge benefits that nanoparticles can bring to the food industry, the public is very concerned about their toxicity and potential negative environmental impact. Due to the health consequences of the nanoparticles entering the human body, their potential risks to human health need to be assessed without delay **[5]**. In his paper, Halliday points out that EU regulations on food and food packaging require a specific risk assessment before nanomaterials are placed on the market **[18]**.

In the course of our research, it was examined to which extent the concept of nanotechnology in the food industry has spread in the public consciousness, i.e., presumably how many people are aware of this technology and its potential application in the food industry. Following this, it was assessed how receptive consumers were about the technology, how they saw its future, and whether they would be willing to buy nanofoods. In our work, the potential dangers of nanotechnology were analyzed, and also the areas in which they may occur, as well as how attitudes, consumer acceptance and willingness to buy change in the light of this.

2.1.1. Foods and packaging materials produced using nanotechnology – some examples [1]

2.1.1.1. Creamier ice cream with unchanged fat content

When making ice cream that is creamier than traditional ones, titanium dioxide consisting of nano-sized grains is added to the raw material of ice cream to increase its creaminess and improve its taste, while keeping its fat content the same as that of traditional ice creams. In its nano form, titanium dioxide is thought to be cytotoxic, however, no data have been found in the scientific literature on the mechanism of absorption of nano TiO_2 from the intestinal tract.

2.1.1.2. Table salt and sugar that do not form lumps with moisture

Nano-sized particles of titanium dioxide are added to table salt and sugar as anti-caking agent. For toxicological aspects see Section 2.1.1.1.

2.1.1.3. Fruit juices enriched with bioactive molecules

Bioactive molecules such as phytosterols, vitamins and antioxidants are added to fruit juices by the way of nanoencapsulation to improve them. Nanoencapsulation is not known to have adverse health effects.

2.1.1.4. Bread enriched with omega-3 fatty acids

Omega-3 fatty acids are added to bread by nanoencapsulation; this way the unpleasant taste of the fatty acids is not felt, and thus the fortified bread retains its traditional taste. Nanoencapsulation is not known to have adverse health effects.

2.1.1.5. Plastic bottles for beer

Beer bottles with a modified composition are produced by adding a nanocomposite material containing clay particles. The purpose of clay-polymer nanocomposites is to minimize carbon dioxide loss and oxygen uptake to extend the shelf life of carbonated beverages. The toxicological effects of the nanolayer are unknown; it has not yet been demonstrated that nanoparticles can be released from the packaging material.

2.1.1.6. Antimicrobial food packaging for meat and other foods

Food packaging materials containing active nano-silver inhibit the growth of microbes and help to prevent possible bacterial contamination. Nanoparticle-sized silver is presumably cytotoxic. It has not yet been demonstrated that nanoparticles can be released from the packaging material.

3. Materials and methods

To answer the research questions, online questionnaire interviews involving 200 people were conducted. During the sampling, the snowball method was used, i.e., the selection of the sample was not random, but in this way we were able to reach a wide range of respondents. Under these conditions, the survey cannot be considered representative, the results obtained can only be applied to the actual respondents. Background variables of the questionnaire included gender, age, place of residence, education and average income.

In the course of the questionnaire survey, consumer attitudes towards nanotechnology in the food industry were assessed using 17 closed-ended questions. Then, in order to be able to analyze them in depth, two focus group studies were conducted. Consumers' attitudes towards the topic were determined in advance by screening questions, based on which they were classified into one of the two focus groups. The first group included consumers who rejected nanotechnology based on the screening questions, while participants in the second group viewed this technology favorably. During the formation of the two groups, we sought to ensure that the consumers interviewed were included in the research in an equal distribution with regard to gender. In terms of age, people between the ages of 20 and 65 participated in the interviews.

Due to the pandemic situation at the time of the research, the two groups of eight people each were interviewed via an online platform.

At the beginning of the focus group interviews, participants were asked to briefly introduce themselves, and then two passages, taken from Sodano et al.'s communication and translated into Hungarian **[1]**, were read aloud in the first half of the discussions. The first text introduced nanotechnology in general, while the second part described six products that had been made by some kind of nanotechnological process, but only the advantageous properties of the products have been emphasized in the description. The first half of the interview questions concerned the awareness and acceptance of nanotechnology in the food industry, but group members also had to answer questions related to the texts they had heard.

In the second half of the focus group discussion, the part of the text that highlights the potential risks and negative impacts associated with the technology and, thus, the products was read aloud. Following this, once again participants were asked questions, this time focusing on the risks, and it was examined how much their attitude towards the topic had changed.

4. Results and evaluation

In this chapter, the most important results of the primary research are presented, in the order they took place.

4.1. Results of the questionnaire survey

The first question of the questionnaire focused on factors considered important when purchasing food. This was important because, after this, the backbone of the research was the examination of the acceptance of nanotechnology in the food industry, taking into account the categories mentioned here. As can be seen from ***Figure 1***, of the factors listed, taste was mentioned first, i.e., for 76.0% of the respondents taste was the most important consideration when purchasing or selecting a food. Based on the comparison with the background variables, it was revealed that men in the sample had a significantly ($p=0.014$) higher proportion (80.0%) who considered taste important than women (61.2%), and also that consumers who, according to their own statements, live in better-than-average financial conditions (live well on their income and can also save some money) also consider taste to be an important criterion when choosing (88.9%).

Slightly behind, high quality (68.5%) and price (63.5%) was second and third in terms of purchasing considerations. As had been expected previously, for these categories, 86.2% of those with a sound financial background rated high quality as an important aspect, while in terms of price, this proportion fell to 47.3%.

High food safety was considered important even less than one half of the respondents (47.0%), which may be due to the fact that they were not aware of the specific meaning of the term.

Respondents considered added value (for example, higher omega-3 fatty acid content) to be the least important aspect, with this factor ranking last of the listed ones with 17.5%. Only 20.0% of men and 16.4% of women consider this category when purchasing food. In terms of financial status, this criterion was least important for consumers with below-average income (7.0%).

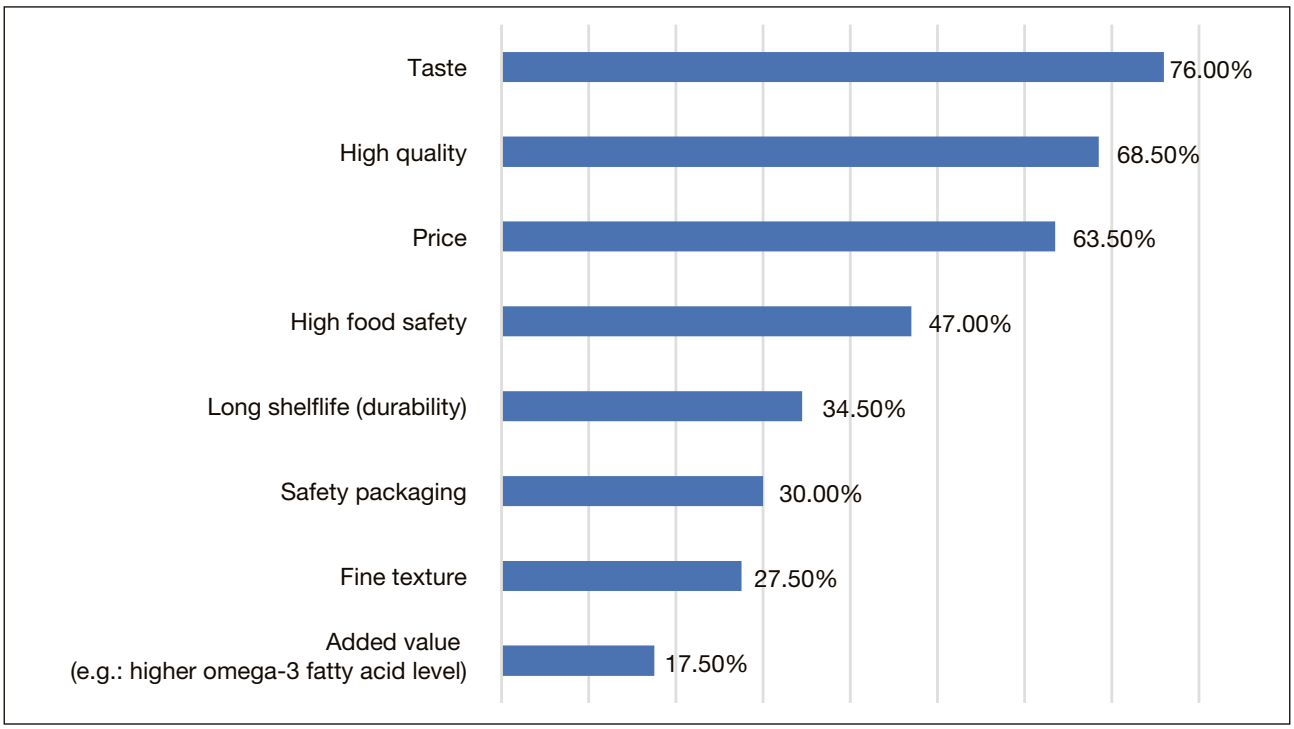

Figure 1. Aspects considered important when buying food (N=200)

In the following, the proportion of respondents with knowledge on nanotechnology in the food industry (spontaneous recall) was examined. The innovative and novel nature of the technology is also supported by the fact that only a quarter of respondents have heard of it.

When the four categories of nanotechnology currently available in the food industry were also listed **[6, 7, 8, 9]** (supported knowledge), only 62.0% of consumers still answered that they had not yet heard of the new technology in question (***Figure 2***). Of the entire sample, there was only one person who had heard of all the categories listed. Of the four categories, packaging materials made using nanotechnology were the best known (28.5%). 11.5% each of the participants in the survey have already heard of nanostructured food ingredients and materials, as well as the use of food contact nanomaterials, respectively. Respondents were least familiar with nanostructured delivery systems, the proportion in this case was not even 5.0%. Consumers who have heard of this category had some kind of college degree.

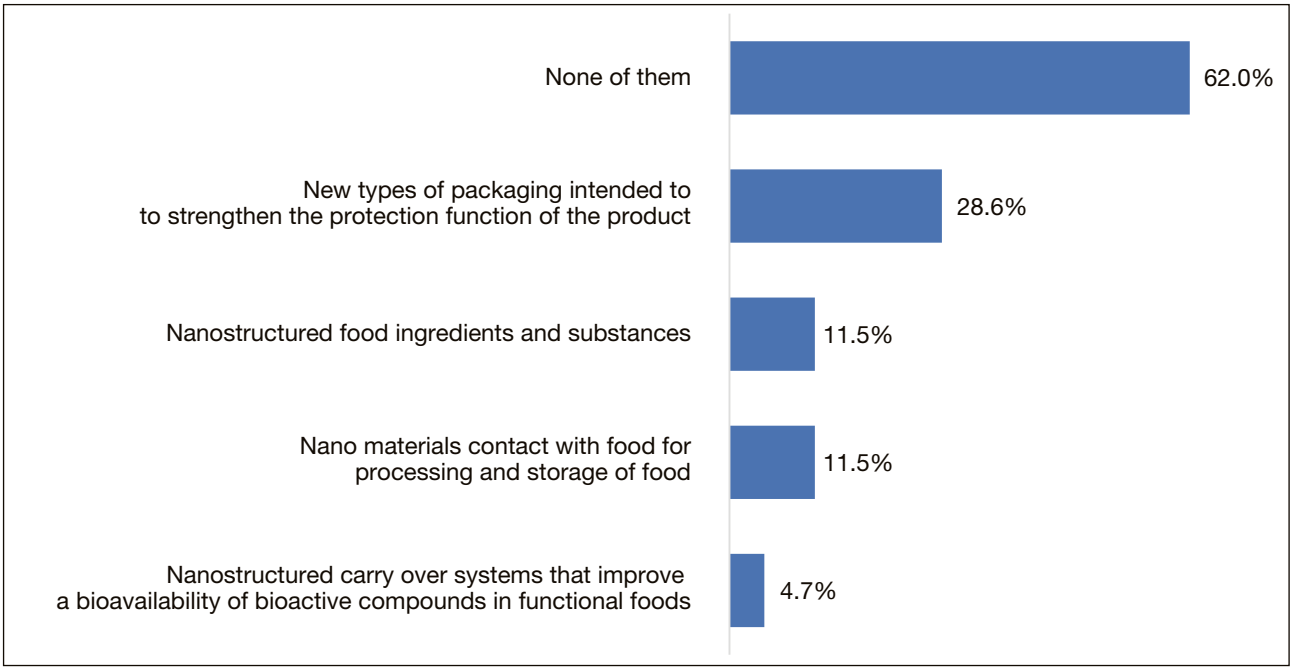

Figure 2. Knowledge of the four categories of food nanotechnology among respondents (N=200)

In the following, the acceptance of nanotechnology in the food industry was examined using the aspects listed in the first question that were considered important at the time of purchase. The results are shown in ***Table 1***.

Table 1. Willingness to buy food produced by nanotechnological development, taking into account certain aspects (N=200)

Would you buy any food, ...	**Answer**	
	Yes (%)	**No (%)**
...which has been produced by nanotechnological development if it will thus taste better?	71.9	28.1
...which has been produced nanotechnological development if its texture is thus more pleasant?	68.8	31.3
...which has been produced by nanotechnological development if its shelf life is thus significantly increased?	62.5	37.5
...which has been produced by nanotechnological development, if this guarantees better food safety?	78.6	21.4
...which has been produced by nanotechnological development if it has added value such as higher omega-3 levels?	63.0	37.0
...whose packaging has been developed with nanotechnological development, thus ensuring safer storage?	78.1	21.9

Based on the results obtained (for the sample), it can be said in general that the majority is open to the new technology if it has a beneficial effect on one of the properties of the food purchased. 71.9% of respondents would buy food made with nanotechnology if its organoleptic properties were better. Of the aspects considered important when buying food, taste finished first: 76% of respondents chose this factor. It should be noted that a greater willingness to buy due to more favorable sensory properties was an expected outcome. The older age group gave the highest proportion of affirmative answers to this characteristic (89.5%, p=0.047), and there was no significant relationship to the other background variables. In order to have a positive effect on the texture of foods, 68.8% of the consumers in the sample would buy a product made with a nanotechnological process. In the hope of better texture, 85.2% of respondents aged 56-65 would be open to buying products made with the new technology. A significant increase in the shelf life and use-by date of foods due to the nanotechnology process had an incentive effect on shopping for 62.5% of respondents. In the case of this question, a significantly higher proportion of women answered yes than men (women: 70.0%, men: 46.3%). 78.6% of the respondents to the questionnaire would buy food made with some kind of nanotechnology process if it increased food safety. 90% of the older age group and 78.6% of women were represented in the „yes" answers in this regard. 63.0% of respondents answered „yes" to the question of whether they would buy a food produced with nanotechnology development if it has added value such as a higher omega-3 fatty acid content. This represents an exceptionally high proportion considering that added value as a purchase criterion finished last in terms of importance with 17.5%. Thus, although it is typically not an important factor for the consumers in the sample that the food has some added value, they would still choose a product manufactured with nanotechnology that is richer in omega-3 fatty acids. Finally, 78.1% of respondents were open to food packaging produced with a new method that guarantees safer storage. In this case as well, women and those aged 55-65 had the highest proportion of „yes" answers.

Figure 3 illustrates how many percents more respondents would be willing to pay for a food that has been produced or modified using some kind of nanotechnology process. Typically, the additional cost consumers in the sample considered most acceptable was between 0% (i.e., they would not pay more at all for a product manufactured with this technology) and 5-10% (30.7% and 30.7% of respondents, respectively). 22.4% would pay 0-5% more and 15.6% would pay 10-20% more for this type of food. The proportion of respondents willing to assume an additional cost of more than 20% did not even reach one percent. Consumers who would be willing to pay 0-5% more for a product manufactured with nanotechnology are those who have a lower-than-average monthly net income, while respondents who say they live in better-than-average financial conditions would be willing to pay 5-10%, 10-15%, 15-20%, or even more than 20% more for such foods.

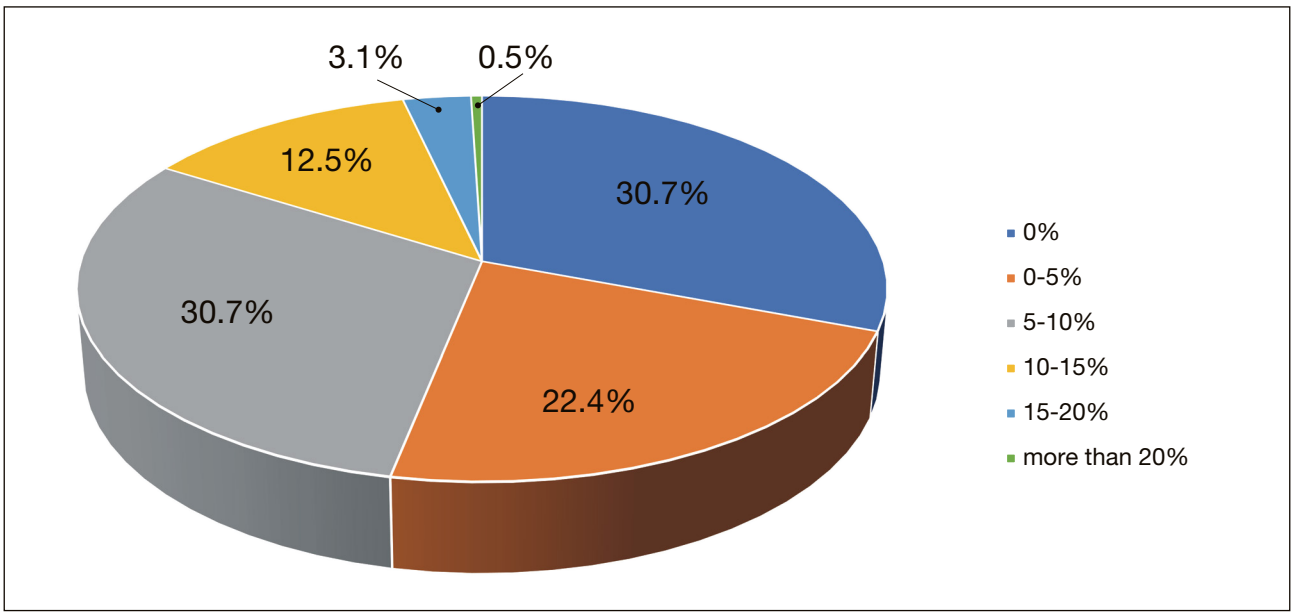

Figure 3. Willingness to pay extra for foods made with nanotechnology (N=200)

In our research, it was also addressed how respondents felt about the possible adverse consequences of nanotechnology in the food industry. Based on the results obtained, it was found that more than half of the questionnaire respondents (53.6%) believed that foods made with the nanotechnology process carry unknown hazards. In this case, in terms of proportions, men can be said to be the most skeptical, with 74.3% saying that nanotechnology in the food industry could pose a risk.

Figure 4 shows the probability of the occurrence of the different hazards in the opinion of the respondents in percentage distribution. 71.4% of respondents who consider the technology to be risky believed that foods made with the nanotechnology process pose mainly health risks. This was followed by environmental risks (56.3%). In this case, almost twice as many women believed that nanotechnology in the food industry could cause environmental damage (p=0.020). Consumers in the sample considered negative economic and social impacts to be the least probable. For these two categories, typically women were also in the significant majority (p=0.001). However, it can be said for all categories that respondents with higher education represented a higher proportion.

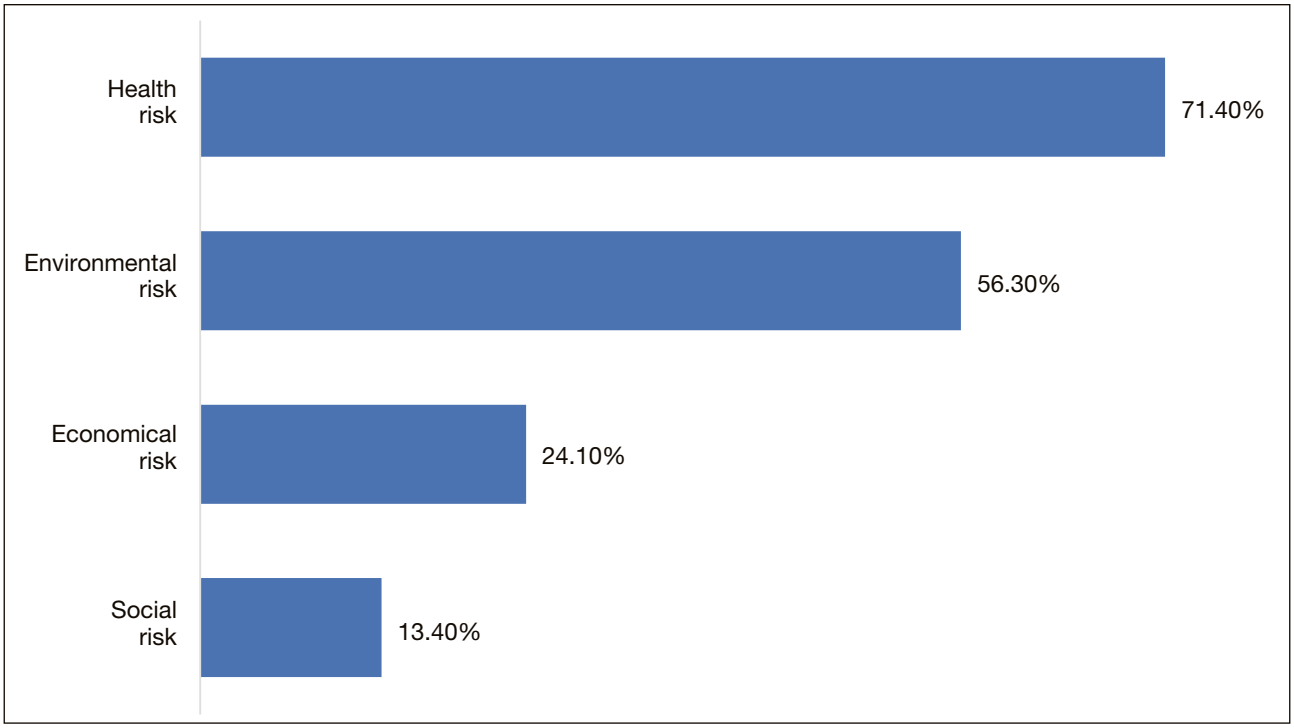

Figure 4. Probability of occurrence of potential risks of foods made by nanotechnology according to the respondents (N=107)

4.2. Results of the focus group studies

Since the main objective of our research was to examine nanotechnology in the food industry from a consumer perspective and to explore the expected rate of acceptance and possible rejection of the technology, after examining the quantitative results of the online questionnaire, it was considered appropriate to analyze the responses received in more depth using a qualitative method, therefore, focus group interviews were conducted to facilitate interpretation.

4.2.1. Results of the focus group study of people accepting nanotechnology in the food industry

Our discussion began with an association game designed to resolve any anxieties of the interviewees. Members of the group were asked to say positive and/or negative words and phrases that come to mind in connection with the topic. The following words were mentioned: *innovation, invention, new opportunities, interesting, sci-fi, foods of the future, possible solutions to many problems.*

The next question was whether they had already encountered any of the listed categories of nanotechnology applications or something similar (creamier ice cream with the same fat content; salt and sugar that do not form lumps with moisture; fruit juices enriched with bioactive molecules; bread enriched with omega-3 fatty acids; plastic bottles for beer; antimicrobial food packaging for meat and other foods). All of the respondents had already met soft drinks and beers packed in special PET bottles. Fruit juices enriched with various vitamins, minerals and antioxidants were mentioned by several people, and one person saw bread enriched with omega-3 fatty acids in a store while shopping (he didn't remember exactly which store it was). In addition to the categories read aloud, they have seen eggs that contained excess omega-3 fatty acids, known various dietary supplements to which vitamins, minerals or antioxidants were added, and a participant had read on the internet about an intelligent packaging material that recognizes contaminants. He did not remember whether the packaging material had been made with nanotechnology in the food industry, but he believed that this category fit exactly into this topic.

Following this, those present were asked to express their views and evaluate how they perceived the six categories described above. Positive thoughts were associated with the products by everyone. They were thought to be useful in many ways, and it was thought to be a good idea to add such extra values to foods that allow people to get vitamins and other minerals without having to take separate capsules into their body. According to the participants, the facts that the use of nanotechnology can make food storage safer and increase shelf life can also be advantages. When asked if they would like to buy this type of food, all participants answered in the affirmative. One person stated that he was somewhat averse to nanotechnology-modified ice cream, while two people said the same thing about bread enriched with omega-3 fatty acids, but they could not specifically explain why.

This was followed by solving a task together, in which members of the group were asked to jointly establish an order for the six products based on which they considered to be the most sympathetic and which the least. The popularity of the products is illustrated by the data in ***Table 2***.

Table 2. Order of listed categories of food nanotechnology by popularity among acceptors

Category	Ranking
Fruit juices enriched with bioactive molecules	1st
Salt and sugar that do not form lumps with moisture	2nd
Bread enriched with omega-3 fatty acids	3rd
Antimicrobial food packaging for meat and other foods	4th
Creamier ice cream with the same fat content	5th
Plastic bottles for beer	6th

The group unanimously agreed with the assumption that in the future we would encounter many of these or similar products on store shelves. It was thought that foods produced with nanotechnology were likely to become more widespread if the pace of food industry developments remained the same. One of our interviewees said that due to the overpopulation of the Earth and the constant decline of arable land, it will be necessary to deploy such tools in order to avoid an increasing rate of hunger and malnutrition, and to prevent people from suffering from the lack of certain nutrients. Everyone has accepted the vision that foods produced with such technology and other similar developments will become more popular and accessible, provided, of course, that they will be available at affordable prices. Intelligent food packaging that recognizes bacteria and contaminants has been found to be especially useful and practical.

According to them, basic foods (dairy products, pasta, flours, cereal flakes) could also be enriched with added values (vitamins, minerals, antioxidants).

In the second half of the focus group interview, the part of the texts was read aloud that described the potential risks involved in using the technology. Following this, it was assessed whether participants' opinions, attitudes and willingness to buy changed as a result of what they had heard. The majority believed that if it were not safe to consume a product, it would ultimately not be able to be marketed. According to another opinion, while it sounded a little scary, and so he would think twice about buying this type of product, he still would not reject the technology.

Finally, participants were asked to reconsider, in light of the information they had learned, the order established above, as to which category they would be most likely to purchase. For better comparability, the order before describing potential hazards and the new order are listed in the same table. The results are shown in ***Table 3***.

Table 3. Order of the listed categories of food nanotechnology according to preference before and after the description of the potential risks among the acceptors

Category	Original ranking	New ranking
Fruit juices enriched with bioactive molecules	1st	1st
Salt and sugar that do not form lumps with moisture	2nd	6th
Bread enriched with omega-3 fatty acids	3rd	2nd
Antimicrobial food packaging for meat and other foods	4th	4th
Creamier ice cream with the same fat content	5th	5th
Plastic bottles for beer	6th	3rd

Although the final order was changed at several points, the opinions and willingness to buy of the group members did not change significantly after the exploration of possible dangers.

4.2.2. Results of the focus group study of people rejecting nanotechnology in the food industry

The study scenario in this case was the same as it was for the previous group. Presentation of the first part of the text was followed by an association game, the essence of which was that participants had to say adjectives and expressions, whether positive or negative, that came tom mind about nanotechnology. This time, compared to the interviews with the accepting group, the opinions (answers) were much more mixed: *innovative, dangerous, bizarre, this is the future, foods made in a laboratory, unnatural*. One of our interviewees also noted that these products were likely to be very expensive.

Of the six products made with nanotechnology in the food industry, half of the group had already encountered fruit juices enriched with bioactive molecules, and everyone was familiar with the special PET bottles. As similar products, sports drinks and dietary supplements fortified with vitamins and minerals were mentioned, which had already been encountered by them in retail trade, and one person had already read online about packaging materials made with nanotechnology, and another participant cited a scientific paper on artificial meat as an example.

Following this, once again, members of the group were asked to share their views on the six products which had been introduced at the beginning of the interview. Someone thought it was extremely scary to hear about these, while others thought that they would be very unhealthy for sure. Many people felt that it was unnecessary to enrich fruit juices with such substances when they were already *full* of vitamins anyway. The idea of bread enriched with omega-3 fatty acids was specifically thought to be „crazy". One participant did not consider packaging to be a bad idea, and two of them also commented favorably on PET bottles.

When asked whether they would buy these products, the answer was clearly *no*. The group was less prone to rejection in the case of the PET bottles, with 4 people inclined to buy, and one person said the same about antimicrobial packaging.

Subsequently, the group rejecting nanotechnology also had to jointly establish an order for the six products, based on acceptability (in this case, we cannot speak of popularity, as the members of the group reject nanotechnology in the food industry). The results are shown in ***Table 4***.

Table 4. The order of the listed categories of food nanotechnology based on consumer acceptance among rejectors

Category	Ranking
Plastic bottles for beer	1st
Antimicrobial food packaging for meat and other foods	2nd
Salt and sugar that do not form lumps with moisture	3rd
Fruit juices enriched with bioactive molecules	4th
Bread enriched with Omega-3 fatty acids	5th
Creamier ice cream with the same fat content	6th

Regarding the vision for the future, participants believed that the trend of developments suggests that more and more products of this kind will be available commercially. There was also a remark in this regard that „the world is not moving in the right direction". One person added that he was confident that we would stick to natural food sources. Several people agreed with the statement that if it is not the food industry that works with such technology, but the construction or textile industry, it may even be useful. When asked whether they would like more of these products to be available in the future, the group's response was a clear and consistent *no*.

The final chapter of the focus group interview concentrated on the potential risks of nanotechnology. After discussing the potential dangers of nanotechnology with participants, their opinions were asked. Their position did not change much after what they had heard, since, as they said, they had not considered it to be a good idea, and it only strengthened their belief that such a technology could have negative consequences. The unanimous opinion of the group was that they would continue to not buy such products as they are sure that they are harmful not only to human health but also to the environment.

As a final task, participants were asked to, in possession of all the information, jointly establish a new, final order as to which category they would consider most acceptable and which least acceptable. Compared to the previous one, the order did not change much, and the result was as follows. The orders before and after the description of the risks (new order) are shown in ***Table 5***.

Table 5. Order of listed categories of food nanotechnology according to acceptance before and after description of potential risks among rejectors

Category	Original ranking	New ranking
Plastic bottles for beer	1st	1st
Antimicrobial food packaging for meat and other foods	2nd	2nd
Salt and sugar that do not form lumps with moisture	3rd	5th
Fruit juices enriched with bioactive molecules	4th	4th
Bread enriched with omega-3 fatty acids	5th	3rd
Creamier ice cream with the same fat content	6th	6th

5. Conclusions

Despite the fact that 74.5% of the respondents were not previously familiar with nanotechnology and its application possibilities, and almost half of the respondents believed that it involved some risk, the survey of knowledge of nanotechnology and the examination of consumers' willingness to buy revealed that the degree of acceptance of the technology and the willingness to buy can be said to be very favorable. If, through this technology, food quality is expected to change in a positive direction, acceptance exceeds 60%.

The most important aspect when buying foods was taste, while added value finished last with 17.5%. Nevertheless, 63.0% of those who completed the questionnaire replied that they would buy a product made with a nanotechnology process if the product thus contained some kind of added value.

The focus group interview revealed that the group of acceptors, as expected, was extremely positive about the technology, and even after the description of the potential risks, neither their opinion, nor their willingness to buy typically changed.

Reaffirming Berekaa's claim that the public is very concerned about toxicity and potential negative environmental effects **[5]**, in the case of the group of rejectors, participants unanimously stated that the technology is extremely risky and dangerous to both the environment and humans. However, they also added that in their view and based on the trends, the proliferation of commercially available such products will be inevitable in the future. In their case it can be said that although they do not prefer the possibilities of using nanotechnology, their rejection was less pronounced for those categories of application of the technology that do not specifically change the properties of foods, but their peripherals (such as packaging).

In Chapter 3 of our paper, the statements of Sodano were already quoted, according to which the willingness to buy nanofoods for the six categories examined (creamier ice cream with the same fat content; salt and sugar that do not form lumps with moisture; fruit juices enriched with bioactive molecules; bread enriched with omega-3 fatty acids; plastic bottles for beer; antimicrobial food packaging for meat and other foods) depends to a large extent on the assessment of the perceived risks and benefits **[1]**. Our results obtained in the course of our research support this, as the willingness to buy of consumers who already had a positive attitude towards the technology is also very favorable, while rejectors showed the opposite consumer behavior.

6. Acknowledgment

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