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INVESTIGATING THE CREDIBLITY OF HEALTH PROTECTING FOOD PRODUCTS

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1. BACKGROUND OF THE WORK, OBJECTIVES

What influences consumers to believe that the food the manufacturer is offering will actually provide the benefits that are claimed on the packaging? What factors are involved in the perception of the health benefits of foods, especially functional foods? The importance of credibility and believability is best illustrated by the fact that it is an area of research that is frequently investigated by many disciplines, including consumer research. There are many segments of consumer research that ask why do consumers believe what the manufacturer is offering them with the product?

One of the questions I was looking for in my PhD research was how external product attributes influence the consumer's perception of the health impact of a functional food. Food marketing research and companies are increasingly focusing on consumer perception of products with credibility attributes. Health impact is typically one such attribute; consumers may not be certain of the health benefits promised by a product even after consumption. A key feature of functional foods, on the other hand, is that they have some additional health benefits over and above the nutritional ones (DIPLOCK et al., 1998). My research is based on the hypothesis that the plausibility of a health effect has a strong influence on the propensity to buy functional foods. Given that one of the main developmental goals of fortified foods is to provide the consumer with foods that offer additional health benefits beyond the basic nutritional benefits, it is crucial that the manufacturer communicates and demonstrates this in the most credible way possible.

Among food development trends, especially for organic and functional foods, it is important to identify what makes the health benefits of the product plausible. The importance of products that are perceived to be healthy is growing, but we do not know what factors influence consumers' perceptions of the health benefits of a product, or what sources they use to gather credible information about the health benefits of products. In a market such as functional foods, where product failure rates are extremely high (MENRAD, 2003), it is important for companies to know their consumers as well as possible. One of the objectives of my research is to use marketing research tools to broaden the knowledge of the food industry specifically for the development of health-promoting foods or foods that are perceived as healthy. The main aim of my research is to explore in more depth the types of messages they find credible about the health benefits of a product, what influences them in their decision to buy. In addition to collecting and classifying these factors, my research aims to determine the weight of these characteristics in the

perception of health benefits. In this way, a picture can emerge of how to communicate the health benefits of a food in order to ensure that the consumer accepts and believes the claim that the manufacturer wants to make about the food, i.e., that it is beneficial to health.
To achieve these objectives, a deep analysis of the literature was essential. My objectives were to identify, based on the international literature, the factors that influence the plausibility of functional foods in particular and to assess the characteristics that influence the perception of health benefits of foods in general.
An important hypothesis of the research is that consumer perceptions of the health benefits of food are largely determined by the ingredients of the product. Appropriate labelling of a well-known and perceived health-beneficial ingredient (as an added ingredient in a suitable food) has a significant impact on consumers' perception of the product as health-beneficial (TEMESI - HAJTÓ, 2014).
The objective of my research is to assess which extrinsic attributes, in combination, are the most credible ways to show the consumer that a product is beneficial to health. The characteristics included in the study were selected on the basis of a review of the literature: I investigate the impact of multiple ingredient and health claims, the impact of organic and domestic (Hungarian) origin, and the impact of packaging shape and colour. In this context, 3 hypotheses were formulated.

H1.: A claim related to an ingredient has a stronger influence on the assessment of the health benefits of the functional-test product than displaying a health claim.
H2.: Of all the factors examined, the organic-origin will have the strongest impact on perceived healthiness.
H3.: Information on domestic origin has a positive effect on the assessment of the health benefits of a product.

In addition to investigating the role of different external characteristics, my other main research objective is related to the disease-preventive effects of functional foods. The spread of civilisation diseases poses a number of social and economic risks. Consumers are more or less aware of the link between diseases and lifestyle. However, we do not know which prevention methods consumers would use to avoid/treat each specific disease, so my research sought to answer this question by asking them.
According to the WHO (2014) data, cardiovascular diseases accounted for the largest share of all deaths in the Hungarian population, 49%, while various cancers were responsible for 26%. Chronic respiratory diseases (4%) and diabetes (2%) accounted for a much smaller proportion. We are familiar with

the factual figures, but not with the consumer perceptions of which diseases worry them, which do not, and which they would make financial sacrifices to avoid. My aim is to assess which diseases respondents are willing to make a financial sacrifice to avoid and would spend this on functional foods.

2. MATERIALS AND METHODS

2.1. Secondary research

To carry out this research, it was necessary to conduct both secondary and primary research. Two literature reviews were conducted prior to the primary research.

In my research, I used several search engines to help us summarize the current view of the researcher community on the topics at hand. Although several review articles have summarized the research findings on functional food products (KAUR - DAS, 2011, SIRÓ et al., 2008), while others have addressed a specific area of interest related to functional food products (ADEMOSUN et al., 2018, BIMBO et al., 2017, KAPINOVA et al., 2017, REIS et al., 2017), in recent years, none has directly focused on examining the relationship between credibility and the willingness to purchase/pay. I have used the search fields of Science Direct, Scopus, Emerald Insight and Wiley Online Library.

In my review, I only included articles written in English; articles in other languages as well as articles with a considerably different focus from my theme were excluded. My article summarizes the findings of 54 studies up until 2017. On the issue of credibility, I went back until 2005, and on the issue of willingness to purchase/pay, until 2010; the gap between the two time periods is explained by the research activity on the two issues – willingness to purchase/pay is a more researched topic than credibility. I have to differentiate between willingness to purchase and willingness to pay, so I will later address them separately; finally, I summarize the research on credibility, which I believe influences both willingness to pay and willingness to purchase.

The initially more than 1500 articles were reduced to the selected 54 in two steps. In the first step I screened out the review-type articles, books, book excerpts, conference papers or other miscellaneous publications. In the second steps, I excluded duplicates, those with a focus on another field of science, or those that did not center on consumer behaviour. At this step I also excluded articles the main question of which did not relate to my review based on their title or abstract, even though they included the search words, or their main research objectives and field of research significantly differ from the questions I examined.

For my second literature review, just as in the first, I used several search engines to access articles on consumer perceptions of the healthiness of food.

In an attempt to access the articles related to the perceived healthiness of food, I employed several search engines in my literature analysis. In recent years, numerous review-type articles touching on the topic of healthiness have been

published (NIEBYLSKI et al., 2015, PROVENCHER - JACOB, 2016, RIEBL et al., 2015), but they only fleetingly mention the issue. The present literature review, however, specifically approaches the topic from the consumers' point of view and so examines the factors which, according to research literature, influence consumer perception of the healthiness of food.
Articles published between January 1, 2014 and March 31, 2019 were collected using the following terms:

I. "perceived healthiness of food"
II. "evaluating food product healthfulness" OR "evaluation of food healthiness"

I looked for the terms in the title, the abstract or among the key words; naturally, because of the way they work, there were slight differences when using the different search engines.
In the I. case, on the ScienceDirect surface I looked for the term "perceived healthiness" in the "title, abstract or keywords" fields, while "food" appeared in the "terms" field. On the Emerald Insight surface, I looked for the complete terms in the abstract and the title, while with Wiley Online Library, in the abstract only.
In the II. case, on the ScienceDirect search field first "evaluating healthiness", then "evaluation of healthiness" was in the "title, abstract or keywords" field, while "food" was in the terms field. With Wiley and Emerald Insight, I collected the articles in a similar way, looking for the terms in the abstract only and in the title and the abstract, respectively.
In my analysis, I specifically focused on the products of the food industry, so I did not include research on restaurants, catering establishments, and those on various casseroles, boiled and fried foods served on plates. Moreover, articles on children's dietary habits and on healthy food provision were also not included.

2.2. Primary research

2.2.1. Focus groups

Among the qualitative research methods, focus group method was used. Two focus groups were held on 28th of February and 4th of March 2018, both in Budapest, at the Buda campus of the University. Participants were recruited by completing an online questionnaire. With the screening questionnaire, I aimed

to achieve as much mixed group composition as possible, thus achieving one of the major advantages of focus groups, namely the observation of the evolution of opposing opinions. Thus, I not only took demographic aspects into account, but also whether the person follows a special diet, how health-conscious they consider themselves to be, and what their shopping habits are. Both the first and second groups had 6-6 participants, each lasting about 2 hours.

At the beginning of the focus group, after the introductions, an association game was used to help the participants to get attuned to the research topic. This was followed by a discussion on the importance of the different statements. I asked respondents to collect the claims they encountered on a food in general, and then asked them to do the same for claims specifically related to health/sustainability/social problems. They were asked how much these claims influence them in their purchases. They were then asked about different concepts, ranked them in order of importance and explained them in different ways.

In the subsequent focus group phase, I looked specifically at functional foods. I asked them what they considered to be the health benefits of a food, and I specifically drew their attention to factors previously found in the literature. I then asked participants about the results of a previous study presented at the XII International Nutrition Marketing Conference (TEMESI - SZAKÁLY, 2016). The research involved assessing the persuasive aspects of the health benefits of food and ranking these aspects. In the focus group, I sought to find out what reasons participants saw behind the ranking.

2.2.2. Data collection – role of functional food products in disease prevention

As part of the dissertation, the results of a previous consumer survey were also analysed. In my research, I conducted a survey with personal interviews (PPI) with 1027 participants between March 4-19, 2013, at busy transport hubs of 5 big cities of Hungary, namely in Budapest, Pécs, Sopron, Nyíregyháza, and Szeged. The respondents were rewarded with a small non-food gift for participating in the survey. At the beginning of the survey, participants were informed about the aim of the research; at the same time, the responses were anonymous.

During the data collection quota sampling have been employed, as opposed to probability sampling, so my sample significantly follows the segmentation of

the society. Among my respondents, compared to the population, the ratio of people between ages 36-50 and >50 is smaller, and the ratio of those living in Budapest and having tertiary education is higher.

After collapsing the results, I used the statistics software SPSS 25.0 to analyse the answers. The collected data were first analysed through descriptive statistical methods, followed by binary logistic regression to find the differences based on demographic variables.

In the course of the regression analysis, I considered only respondents who were concerned about and would make a financial sacrifice to avoid the disease under investigation. In the models employed, the dependent variable was the financial expense of the prevention method (purchasing functional food (Y/N)) chosen in order to avoid the specified disease, and the independent variables were the characteristics of the respondents. In my analyses, I applied the 5% significance level ($p<0.05$) and the Forward Wald method.

The principle of triangulation provided another perspective from which my study approached the research questions related to the identification of diseases that consumers would prevent with the help of functional food products, and the socio-demographic features that have a stronger influence on this choice.

With the aim of forecasting consumer choice, I ran additional statistical analysis on the data. Random Forest is a method widely used for making predictions, with the advantages of being wieldy, robust, and fast (GUPTA - GUPTA, 2019). I used the Random Forest package of the R statistical software to examine the extent to which consumer choice can be predicted. The analysis was conducted by including all the examined variables. “Random forests are a combination of tree predictors such that each tree depends on the values of a random vector sampled independently and with the same distribution for all trees in the forest” (BREIMAN, 2001, p. 5). During the analysis, I used the "OOB Estimate of error rate” value to examine accuracy, and the “MeanDecreaseGini” values to examine the importance of the analyzed variables. With each analysis, 70% of the total sample was used for training and 30% was used to validate the models.

2.2.3. Choice based conjoint analysis

My data collection methodology was online consumer questionnaire, which yielded 633 respondents during November and December 2020. Data collection took place on the university’s social media interface, through paid advertisement. Respondents gave written consent for their answers to be

analyzed. My research did not aim at a representative sample, and as a result of online sampling, the distribution of the respondents is biased in several respects, such as the respondents' education or gender.

The questionnaire used in the consumer survey can be divided into three main parts. In the first part, I asked respondents to choose between the products with different designs. Then, I asked respondents to evaluate attitude statements which later provided a basis for differentiating between the individual consumer groups. The claims related to healthy lifestyle were measured using elements of the General Health Interest scale (ROININEN et al., 1999), whereas food-related consumer involvement was measured using the corresponding scale of the Food related lifestyle model (BRUNSØ et al., 2021). The third part of the questionnaire included the demographic questions.

Conjoint analysis is a widely used method in behavioural research (GREEN - SRINIVASAN, 1978), used, among others, to assess consumer preferences. To achieve my research aim, I performed choice-based conjoint analysis, during which I showed respondents choice-sets with two product combinations each, from which they could choose one, simulating a scenario close to a real choice situation (HAIR et al., 2014).

To examine the individual levels, I used a smoothie product for several reasons. The market for functional drinks has been increasing in recent years (STATISTA.COM, 2021), and smoothie has become an alternative to healthy eating for consumers (SERPA-GUERRA et al., 2018). In my analysis, I examined the effects of 6 attributes: claims related to ingredients (4 levels), organic origin (2 levels), health claims (3 levels), shape of packaging (3 levels), colour of packaging (3 levels) and domestic origin (2 levels). When completing the questionnaire, respondents always had to choose the picture which they thought presented a product more beneficial to health. The questionnaire did not have a no choice option. Figure 1 summarizes the attributes and their levels.

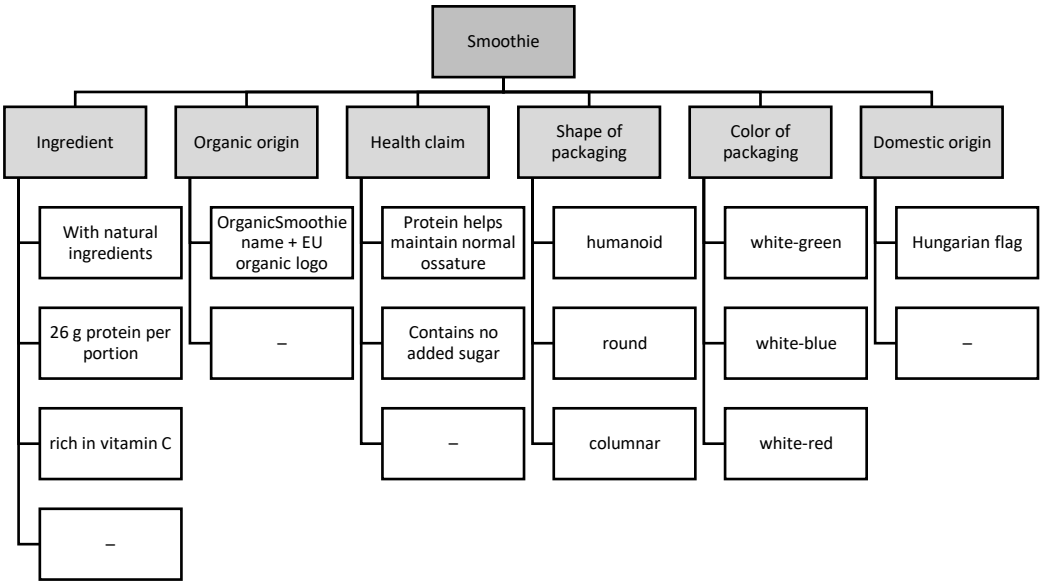

Figure 1 Summary of attributes and levels (source: own edit, 2021)

To create the choice sets, I used AIZAKI AND NISHIMURA's (2008) 5-step description, and based on this, the R statistics (TEAM, 2013). Accordingly, I first created full factorial design with the help of the AlgDesign package. However, given the extremely large number of combinations thus obtained (4x2x3x3x3x2=432), I used orthogonal design, which allows the examination of main effects without having to examine all the combinations that exist (IBM.COM, 2021). Accordingly, 16 combinations were used in the next steps, in 16 choice sets, comparing two product combinations in each case.

Random utility theory states that consumers make rational decisions, maximizing the utility of their decisions. According to the theory, perceived utility (U_j) can be divided into two parts, systematic utility (V_j), and a random component (ε_j) (CASCETTA, 2009), and can be described with the following equation:

$$U_j = V_j + \varepsilon_j$$

Based on the attributes and levels used in my research, the representative component of utility can be described using the following equation:

$$Vj = ß_I Ing_j + ß_O Org_j + ß_H Hcl_j + ß_S Sha_j + ß_C Col_j + ß_{Ori} Ori_j$$

where, V_j is the representative component of utility in the case of *j* smoothie *(j=A,B, A – option 1, B – option 2)*, the value of Org_j is 1 if an organic product

features in the given j combination; if not, then it is 0. The value of Ori_j is also 1 if an indication of Hungarian origin appears in the given j combination; if not, then it is 0. Ing_j, HCl_j, Sha_j, Col_j indicate a claim related to an ingredient, a health claim, shape of packaging and colour used with *j* smoothie. $\beta_I, \beta_O, \beta_H, \beta_S, \beta_C, \beta_{Ori}$ are unknown parameters associated with Ing_j, Org_{j-} HCl_{j-}, Sha_j, Col_j *and* Ori_j.

3. RESULTS AND THEIR DISCUSSION

3.1. Results of the focus groups

In the first half of the focus groups, I asked participants about their perception of the health impact of a food, i.e., what factors influence them when they judge the healthiness of a food. A common theme, and a factor mentioned by both groups, was the extent of their prior knowledge of the products, the ingredients in the product - with a focus on sugar and fat content - and the fact that they tended to perceive products that were less processed as healthier. I also asked for their views on health claims/logos. A surprising claim for those familiar with food regulations was mentioned several times: respondents said that you can put anything on a food.

In the second half of the focus groups, a table presenting the results of the consumer survey was distributed to the participants and they were asked to try to explain the results. In the previous survey, respondents were asked, among other things, to rate on a scale of 1 to 5 how they felt about the health benefits of food. The results showed that they were most influenced by the taste of the product after tasting it and its Hungarian origin, and least influenced by the label/logo proving the certification of the health organisation, the health claim information on the packaging to be able to choose what is really good for them. They may have to look at this information a lot to be able to interpret it properly.

3.2. Results of the choice based conjoint analysis

My main research aim was to identify the extrinsic attribute combination which results in a product that most credibly shows the consumer that it has a beneficial impact on health. I summarize the results of the conditional logit model analysis for the whole sample in Table 1. In the model, the last category of each attribute is a reference category with a coefficient value of 0, so they do not appear in the table.

Table 1. Results of the conditional logit model (source: own edit, 2021)

Attribute – Claim related to an ingredient				
Level of attribute	*Coefficients*	*Exp (coef)*	*se (coef)*	*z-value*
With natural ingredients[a]	0.698**	2.010	0.046	15.168
Rich in vitamin C[a]	0.469**	1.599	0.065	7.211
26 g protein per portion[a]	0.280**	1.324	0.066	4.254
Attribute – Organic				
OrganicSmoothie name + EU organic logo [b]	1.016**	2.761	0.033	30.596
Attribute – health claim				
With no added sugar[c]	0.529**	1.698	0.05	10.476
Protein contributes to the maintenance of normal bones[c]	-0.087n.s.	0.917	0.059	-1.458
Attribute – shape				
columnar[d]	0.315**	1.37	0.053	5.959
round[d]	0.046n.s.	1.047	0.048	0.959
Attribute – color				
white-blue[e]	1.385**	3.992	0.153	9.037
white-green[e]	0.627**	1.873	0.089	7.004
Attribute – origin				
Hungarian flag[f]	0.606**	1.833	0.0572	10.602

a – reference category: packaging with no claim on an ingredient
b – reference category – nonorganic product
c – reference category – packaging with no health claim
d – reference category – humanoid shape
e – reference category – white - red
f – reference category – packaging without a Hungarian flag
* $p<0.05$, ** $p<0.01$, n.s. – non-significant

As the results in Table 1 show, each attribute contributes to the assessment of the health effect of the product to some extent, there was a significant feature for each. Considering the obtained coefficients on the whole, the assessment of health effect is most supported by the color blue as well as organic origin. Based on this, I was not able to verify my second hypothesis, as the organic origin was the second most influential factor and not the first.

In my research, I examined different types of claims, such as claims related to ingredients and health claims. The use of all ingredient claims helps to assess the health effects of a product. However, whereas the use of the claim "*26 g protein per portion*" increases the degree of credibility by 1.3 times (Exp coef = 1.32), and the claim "*rich in vitamin C*" by 1.6 times (Exp coef = 1.6), the

claim "*with natural ingredients*" doubles it (Exp coef = 2.01) compared to not displaying such a claim. My results confirm my first hypothesis, in which I assumed that the use of ingredient claims makes the health effect more credible than health claims.

Scrutinizing health claims and nutritional claims, not all examined factors showed a significant effect. Whereas the applied nutritional claim ("*Contains no added sugar"*) contributes to more credibly showing the health benefits of the product, the effect of the examined health claim is not significant. When displaying this nutritional claim on the packaging, consumers are 1.7 times more likely (Exp coef = 1.69) to consider a product beneficial to health than without such a claim on the packaging.

Scrutinizing health claims and nutritional claims, not all examined factors showed a significant effect. Whereas the applied nutritional claim ("Contains no added sugar") contributes to more authentically showing the health benefits of the product, the effect of the examined health claim is not significant. When displaying this nutritional claim on the packaging, consumers are 1,7 times more likely (Exp coef = 1,69) to consider a product beneficial to health than without such a claim on the packaging. The non-significant effect is likely to be due to consumer scepticism, confirming the findings of previous research that consumers may become sceptical of health claims (ANNUNZIATA et al., 2015, GINEIKIENE et al., 2017)

Examining shape, I concluded that using the columnar shape is the most advantageous, while there is no significant difference between the assessment of the health effect of the round and humanoid shape. If instead of the humanoid shape, the manufacturer uses the columnar shape to package a functional smoothie, consumers are 1.4 times more likely (Exp coef = 1.37) to assess the product as beneficial to health. Regarding color, in line with some previous results (HUANG - LU, 2016, WĄSOWICZ et al., 2015), the significant effect of the color blue can be highlighted, which, of the examined colours, can contribute the most to consumer belief that the product has a beneficial effect on health. If the manufacturer uses the color blue instead of red as the emphasized color of the packaging, it is four times (Exp coef = 3.99) as likely that the consumer will consider the product to be beneficial to health as if the manufacturer had used the color red. This ratio is also significant in the case of the color green, the consumer is nearly twice as likely (Exp coef = 1.87) to assess a green-packaged functional smoothie to be beneficial to health than a red one.

An indication of domestic origin also makes the health benefits of a product more credible, which confirms my third hypothesis. A functional smoothie with an indication of domestic origin on the packaging is nearly twice as likely (Exp coef. = 1.83) to be perceived by the consumer as beneficial to health than a product without such an indication.

Based on the results in Table 1, the product combination considered to be the healthiest is the one that is organic, white-blue in color, includes the statement "*with natural ingredients"*, an indication of domestic origin, a nutritional claim, and is square shaped.

3.2.1. The effects of individual characteristics on valuation

In addition to surveying the whole sample, I assumed that the different characteristics of consumers would result in differences in the assessment of the individual levels. I examined the influence of consumers' general health interest level, involvement with food, and the different demographic features on the assessment of healthiness. I assessed the differences between women and men, those with higher and lower level of education, and those aged under 36 and those 36 years old or older. When examining General Health Interest (GHI), I split the sample into two: respondents with a below average and those with an above average GHI level, based on averaging the values given to the scales. Based on the mean values, I divided the sample into two parts with roughly equal number of elements, then coded it into the table used for the conditional logit model with codes 0 and 1. The code 0 indicated a below average GHI level, and 1 indicated an above average one. I proceeded similarly with involvement, too.
Based on the description of AIZAKI - NISHIMURA (2008), I supplemented the command line run on the whole sample in R with the various criteria and examined the significant discrepancies. The results thus obtained are summarized in Table 2, in which the rows where I found a significant difference are highlighted.

Table 2. Results of the conditional logit model: Interaction effects (source: own edit, 2021)

Attribute – Claim related to ingredient					
Level of attribute	*Interaction effect*	*Coefficients*	*Exp (coef)*	*se (coef)*	*z-value*
With natural ingredients	:gender	0.216*	1.240	0.106	2.021
	:education	0.262*	1.299	0.135	1.931
Rich in vitamin C	:gender	0.407**	1.502	0.149	2.726
26 g protein per portion	:education	0.262*	1.299	0.135	1.931
Attribute – Organic					
OrgSmoothie name + EU organic logo [b]	:General health interest	-0.128*	0.88	0.068	-1.872
	:involvement	0.214**	1.239	0.069	3.090
Attribute – Health claim					
Contains no added sugar[c]	:age	0.502**	1.652	0.106	4.719
Protein contributes to the maintenance of normal bones[c]	:age	0.281**	1.324	0.125	2.251
Attribute – Shape					
round	:General health interest	-0.131*	0.877	0.078	-1.669
	:education	-0.229**	0.795	0.078	-2.937
columnar	:gender	0.239**	1.27	0.12	1.996

** p<0.1, ** p<0.05*

The gender of the respondent influences the assessment of the different levels for two of the six attributes. Women assess the health impact even more credible than men if the manufacturer uses columnar packaging instead of humanoid (Exp coef = 1.27), and women also ascribe greater importance to the statements *Rich in vitamin C* (Exp coef = 1.5) and "*With natural ingredients"* (Exp coef = 1.29).

The age of the respondent gains importance in relation to health claims. Respondents under the age of 36 are more likely to believe the health benefits of a smoothie containing either a nutritional claim or a health claim than the older age group (Exp. coef = 1.65; 1.32). Education plays an important role in the case of two ingredient claims and a shape. As opposed to the manufacturer not using such a claim, respondents with a higher education judged the claims "*With natural ingredients"* and "*26 g protein per portion*" equally (Exp coef

= 1.29 in both cases) more useful when assessing the impact on health than those with a lower education. On the other hand, compared to humanoid packaging, respondents with a higher education are less likely to believe that a product with a round shape packaging is beneficial to health (Exp coef = 0.79) than those with a lower education.
I obtained interesting results related to organic origin. Consumers with a higher general health interest are less likely to believe that an organic product is beneficial to health than those with less such interest (Exp coef = 0.88). Furthermore, those with a higher food involvement level are more likely to consider an organic functional smoothie beneficial to health than the less involved (Exp coef = 1.239). Those with a higher general health interest also assessed the round shape differently: compared to a humanoid shape, they consider it less credible (Exp coef = 0.87) that a product with a round shape is beneficial to health than respondents with a lower GHI level.
In addition to the fact that the manufacturer should pay attention to these differences between target groups, I also conclude that the most prominent factor, the color blue, positively influences the assessment of the effect on health regardless of the examined consumer criteria and attitudes, and I can draw a similar conclusion in relation to the indication of domestic origin.

3.3. Result of the factor and cluster analysis

For the questionnaire used in the conjoint analysis, different attitude scales were also asked. Of these, statements related to food-related involvement and general health interest were also examined using factor and cluster analysis. The aim of this analysis was to assess the characteristics of involuted and less involuted and more and less health-conscious consumers, and the proportion of the sample that is made up of these groups
An interesting result was found with regard to food involvement. Already in the factor analysis it was clear that a significant direction was certain, as the first factor explained almost 75% of the variance. The results of the cluster analysis confirmed this, as the majority of my respondents (459) were classified in the first cluster, while only a minority (173) were classified in the second.
Based on the results of the factor and cluster analysis, the clusters were named Involved and Less Involved consumers. However, no major difference between the two clusters can be detected, with only a few points of disagreement between them. Nevertheless, these are important differences: while the more involved consumers tend to consider eating and drinking as a source of pleasure and an important part of their social life, the less involved consumers tend to consider these two factors as less important.

Demographically, I found an interesting difference in the structure of the clusters in terms of education, but not in terms of age and gender. Although both clusters have a significant share of tertiary education, while the cluster of involuntary consumers is proportionally composed of more respondents with lower education, 95% of the less involuntary consumers have a high school diploma or tertiary education.
Based on the general health interest statements, I was able to distinguish two clusters of similar size, which differ in a number of respects. The health-conscious cluster represents 53.5% of the total sample (339 people). Typically, they tend to place more importance on paying attention to the healthiness of the foods they choose, on a low-fat diet, on healthy snacks and on not raising their cholesterol levels. The second cluster is considered to be the group of people who are generally uninterested in health. This cluster represents 46.5% of the total sample (293 people). Typically, members of this cluster gave neutral answers to statements of general health interest, with a few cases where they tended to move towards statements of disagreement or agreement. For them, it is less important than for health-conscious people that their diet is low in fat, that their daily diet is rich in vitamins and minerals, or that they follow a balanced diet. I have also examined the two clusters in terms of gender, age and education, and I can make notable differences in the composition of the two clusters in terms of gender.

3.4. The role of functional food products in disease prevention

One of the questions I searched an answer for in my research was to identify the non-communicable diseases that concern consumers the most. According to my results, surveyed consumers are most concerned about cancer-related diseases (78%). This same disease is the one with the highest ratio of respondents willing to make a financial sacrifice. A high ratio of respondents would also make a monetary sacrifice to prevent cardiovascular diseases, a weakened immune system, and diabetes. Surveyed consumers are least concerned about migraine and unbalanced mood.
Even though, based on the cited data by WHO (2014), the death rate is higher for cardiovascular diseases in Hungary, respondents are most worried about cancer-related diseases, followed by cardiovascular diseases. At the same time, there is a high rate of concern about diabetes, even though the death rate caused by this disease is much lower compared to the two previously mentioned diseases.

My research also aimed at finding out what exactly, if anything, worried respondents would spend on. The four factors I examined were taking medicines, using dietary and nutritional supplements, consuming functional

foods, and lifestyle changes. My results show that in order to prevent diseases, most people say that they would implement lifestyle changes. Respondents ascribe the biggest importance to it in the case of cardiovascular diseases, which means that consumers would apply this method to prevent the disease which carries the biggest NCD risk in Hungary, based on data by WHO (2014). Thus, I can also conclude that consumers are aware of the connection between lifestyle and the emergence of cardiovascular diseases.
The main aim of my research, however, was to identify the diseases that most people are likely to prevent with the consumption of functional food products. To the question raised by SIRÓ et al. (2008), namely, which are the diseases that consumers would prevent by choosing functional foods, my results yielded the following answer: digestive problems, a weakened immune system, high cholesterol level and diabetes. If I combine this result with the disease that worries respondents the most, I can conclude that functional food products can play the biggest role in the prevention of a weakened immune system for a wide circle of consumers. In his research, KRAUS (2015) ranked the potential health effects of functional food products according to their importance. Consistent with my results, strengthening the immune system and lowering the risk of cancer-related diseases also ranked on top of his list, and improving memory ranked lower.

I considered it important to utilize the characteristics of respondents to identify the groups that can be most associated with specific prevention methods. The odds ratios received from the regression analysis show the values compared to the first group of the variable, that is, we can see the results compared to females in the case of gender; compared to the 18–25 age group in the case of age; to the primary/vocational school educated in the case of education; and a different town or village compared to Budapest in the case of place of living. Regarding the question about the person who does the shopping, the basis of comparison is the case when the respondent does the shopping; to this I compare the case when someone else does it or when it is a shared responsibility. In the case of the statement “I pay attention to healthy eating”, I compare those for whom it is important to those for whom it is not. According to my results, males consider the consumption of functional food as relevant prevention methods to a lesser extent in the prevention of cancer, migraine, osteoporosis, and a weakened immune system. Thus, we can emphasize that in the case of these diseases, it is important that companies address their prevention-related communication primarily at women. This result is in line with previous literature (DE JONG et al., 2003, KRAUS et al., 2017, MEYERDING et al., 2018, URALA, 2005, VERNEAU et al., 2019), which state that women are more open to functional food; at the same time, my results provide a more nuanced picture in that they identify the diseases for the

prevention of which functional food development should be targeted to women.

For six of the 13 examined diseases, I obtained a significant result related to the effect of age. The results show that compared to the 18–25 age group, it was the 36–50 age group that yielded significant differences in the highest number. This age group considered functional food products more important in the prevention of high cholesterol level, diabetes, osteoporosis, a weakened immune system, and digestion problems. For this last problem, buying and consuming functional foods can be an important prevention method also for the 50+ age group, whereas for memory and concentration problems, the 25–35 age group may consider this method. This result of ours clarifies the statements of previous literature (BIMBO et al., 2017, KRAUS et al., 2017, SIRÓ et al., 2008, URALA, 2005, VERNEAU et al., 2019), according to which it is the middle-aged and the elderly rather than the young who would consume such products.

It is also important to highlight the aspect of the person who does the grocery shopping, as for three diseases, I obtained a significant result in this respect. For all of the three diseases, namely, cancer-related diseases, skin diseases, and joint problems, it is a shared finding that respondents in the household of whom someone else does the shopping consider the consumption of functional foods a less relevant prevention method than respondents who themselves do the shopping.

For several diseases, significant results were also found for the highest educational level of respondents. The responses of those with a higher level of education were compared to those that were primary/vocational school educated. In accordance with results of previous research literature (DE JONG et al., 2003, KRAUS et al., 2017, MEYERDING et al., 2018, SIRÓ et al., 2008, URALA, 2005), those with a college/university education consider the consumption of functional foods more suitable for the prevention of certain diseases. Those with a college/university education consider the consumption of functional foods a suitable solution for the prevention of cancer-related diseases, memory and concentration problems, and a weakened immune system, whereas for the prevention of joint problems, it is rather those with a secondary technical school/secondary school diploma who would choose this method.

For certain diseases, place of living or the emphasis on a healthy diet proved to be an important factor. Place of living gained importance with diabetes. Respondents living in the capital consider the potential functional foods less suitable for its prevention. The importance of a healthy diet may play a main role in the choice of products aimed at preventing a weakened immune system or osteoporosis.

Of all the diseases, I obtained the highest exp (B) value related to a weakened immune system. My results show that for the prevention of this disease, it is respondents with a higher level of education who consider the consumption of functional foods the most suitable method.

The proportion of respondents worried about diseases, the form of financial sacrifice among respondents worried about diseases and willing to make financial sacrifices, and the results of binary logistic regression can be interpreted together. The combination of the first two factors mentioned above highlights weakened immune system, diabetes and digestive problems as diseases that worry a significant proportion of respondents, and for which a higher proportion of those worried would also choose functional foods as a preventive measure. Complementing this with the results of binary logistic regression, the different characteristics of the respondents clearly delineate the consumer group who would be more likely to consume functional foods to prevent each disease.

Thus, for the prevention of a weakened immune system, functional foods are considered the most suitable by women, by those with a higher level of education, by the 36–50 age group, and by those for whom a healthy diet is important. If a product manufacturer would like to communicate the prevention of a weakened immune system—an aim towards which, according to my results, 39% of those concerned and willing to spend would purchase functional food—to its future consumers, then it is important for them to assess how to reach consumers with these characteristics. For the prevention of diabetes, it is the 36–50 age group and those living in a place other than the capital who would give an important role to functional foods. In connection with digestive problems, the over 36 age group can be highlighted, as they consider the consumption of functional foods a relevant prevention method for this disease.

The results were also analysed with the random forest method. My aim was to identify the demographic variables that most influence the decisions of consumers who would choose functional food products to prevent diseases. The method worked with the lowest error rate in the case of mood disorders/apnoea, migraine, joint diseases, and respiratory diseases for the grouping of respondents and the prediction of their choice of functional food products to prevent diseases.

The age and education of the consumer have a stronger influence during prediction. Age was more important than the other factors for 12 of the 13 examined diseases, whereas in one case, education was more important. Consumers' place of living emerged among the first three most important influencing factors for nine diseases, whereas in two cases, consumers' BMI rating and perception of income, and in one case, the identity of the primary grocery shopper, were among the most important influencing factors. Contrary

to previous results (DE JONG et al., 2003, KRAUS et al., 2017, MEYERDING et al., 2018, URALA, 2005), which found that an important factor in the consumption of functional foods is the gender of the consumer, in my analysis this factor was not among the top three factors influencing prediction for any of the diseases.

During the triangulation process, I also compared the results obtained via the random forest method with those of the regression analysis in order to arrive at a more accurate and justified result in terms of the most relevant target group for disease prevention through functional foods. The ExpB values of the regression analysis and the MeanDecreaseGini values of the random forest analysis complete each other such that the value of importance indicates the most influential factor in the prediction of consumer choice, while the odds ratio makes it more precise.

This information helps to identify the factors worth emphasizing for individual diseases. In the case of weakened immune system, education is the most important factor for making predictions, and based on the regression analysis, those with tertiary education can be an important target group.

In terms of the age of the consumer, five diseases can be highlighted among those for which age was the most important factor when making predictions. During product development and the preparation of marketing communication, companies should focus on the 36–50 age group for the prevention of high cholesterol level, digestive problems, diabetes, and osteoporosis, the 25–35 age group for the prevention of memory lapses and concentration problems and the 36 or older age groups for digestive problems.

4. CONCLUSION AND RECOMMENDATIONS

At the beginning of my research, I formulated several broad objectives and 3 hypotheses. The hypotheses were firstly formulated in relation to the extrinsic characteristics that influence the perception of health impact. Already in the objectives, I mentioned that an important hypothesis of my research is that a well-placed ingredient claim contributes greatly to the consumer's belief that a product is beneficial to health. Subsequently, the results of a number of studies in the literature and my focus group research have shown that the role of ingredients is undeniably important in determining health benefits. Unsurprisingly, the conjoint analysis also showed claims about the different ingredient to be a pronounced factor, but it was not the most significant extrinsic factor.

In my first hypothesis, I hypothesized that perceptions of the health benefits of food are more influenced by ingredient claims than by health claims. In relation to health claims, it is difficult to say whether they actually help or hinder the communication of health-promoting foods, based on the views of previous research. Some findings suggest that they contribute greatly to consumers' appreciation of the attributes of functional foods, others suggest that they are already an over-communicated environment and that scientifically formulated claims can make consumers sceptical about the effects of the product. This contradiction led us to assume that although health claims will have an impact, it will not be as significant as ingredient claims. I was able to confirm this in the conjoint analysis, because while ingredient claims had a greater impact on consumers, the health claim did not even show a significant effect. Therefore, functional food companies should focus on ingredient claims or on another category of health claims, nutrition claims.

In my second hypothesis, I looked at the bio-origin and the form of packaging. I hypothesised that these two factors would be the most influential characteristics, but I were only able to confirm this halfway. Bio-origin was indeed one of the strongest influences, but form was less significant. Although it was not the aim of my research to investigate the reasons why these factors influence consumers the most, it is important to mention the halo effect that arises in the context of organic origin. Several studies have shown that consumers perceive organic products to be healthier. This was one of the reasons why I assumed this would be one of the most pronounced features. And in terms of shape, of the three shapes studied, the only one that stood out

was the one resembling a hash brown, but that did not feature prominently either. There was no significant difference between the other two shapes (round, humanoid), so their effect cannot be interpreted in terms of health impact.

Regarding colour, my aim was to investigate which of the conflicting results found in the literature would be the most strongly influential and least influential colour in our country. The most significant colour was found to be blue, and the least influential on the plausibility of the health effect was the red colour of the packaging. This may be because, in agreement with the literature, the prohibitive effect of the colour red is also present for this product. However, it should be remembered that there are results that show that the colour red contributes to the perception of health benefits, and it is therefore important to conduct further research on the context in which this colour helps the consumer. And although red is the least significant of the colours, blue is a highly significant colour in terms of its influence on the perception of health impact.

My third hypothesis concerned the positive impact of domestic origin, which I also confirmed. Both the literature review and the focus groups revealed that home origin has a positive impact on health perceptions for different reasons, which was then confirmed by conjoint analysis. However, in addition to confirming the positive effect, I also revealed its weight, with home origin being only the fourth of the six characteristics analysed.

My results are of particular relevance to functional food companies because, in addition to collecting the main extrinsic characteristics that influence perceived healthiness, I have also quantified their weight. This will help manufacturers to present healthiness, which is highly relevant for functional foods, in the most credible way to consumers during the purchase process.

In my multi-part survey, the aim of the section on lifestyle diseases was to assess which diseases are of concern to consumers, which diseases they would make financial sacrifices to avoid, and which diseases they would make financial sacrifices to buy functional foods for. I found that of the 13 diseases of civilisation I studied, consumers would most likely consume fortified foods to avoid a weakened immune system, high cholesterol, diabetes and cancer. In addition, the statistical methods used were used to identify the main target groups for these diseases, based on the sex, age and education of the respondent. My results show that the groups most open to functional foods in terms of disease prevention are women, people aged 36-50 and people with a college or university degree.

The conclusions of the research can greatly help companies developing functional foods to develop their product concepts, which is a prerequisite for successful product launches. My results will help to ensure that R&D resources are spent more efficiently and that companies developing functional foods know which diseases are worth emphasising and which consumer target groups to focus on.

It is recommended that functional food development research, as well as the R&D departments and marketing experts of manufacturing companies, should devote their resources to developing and communicating disease prevention products that are associated with the highest consumer acceptance. This would also be facilitated if international and national applications were evaluated on the basis of whether the proposed functional food development is aimed at preventing a disease that consumers would like to prevent by consuming food. In this way, I can expect to see a significant increase in the consumption of functional foods and thus a greater role for functional foods in improving the health of society as a whole.

5. NEW SCIENTIFIC RESULTS

1) By analysing the international literature on functional foods from 2005-2017, I identified three main lines of research on credibility in the context of functional foods (The source of information, The role of credibility in functional foods, Credibility of health claims) and using a literature analysis based on the international literature from 2014-2019, I structured the aspects influencing the perception of the health impact of food as follows:
    - Taste and other sensory attributes,
    - Impact of different information,
    - product or product category,
    - organic origin,
    - ingredients,
    - and packaging characteristics.

2) Using Conjoint analysis, I determined the weight of extrinsic features found in the literature in assessing health effects of which I have shown that the white-blue colour of the packaging has the greatest influence on the credibility of the health effect of the functional test food under investigation.

3) I have denied that health claims act as a significant influencing factor in judging the impact on health. My results show that nutritional claims and various ingredient claims play a more important role than health claims.

4) I determined the weight of individual factors based on consumer characteristics (general health interest, food-related involvement, gender, age, and education) and their influencing effect in judging extrinsic characteristics.

5) I have identified the noncommunicable diseases that are of greatest concern to consumers and that they would consume functional foods to avoid. Furthermore, I used regression analysis to determine the weight of demographic characteristics in the prevention of diseases by

functional foods and Random forest method to predict the factor that most influences consumer choice.

6. THE AUTHOR'S SCIENTIFIC PUBLICATIONS IN THE FIELD OF THE DISSERTATION

Publication in scientific journals, in foreign languages:

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