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Consumer risk perception of food additives

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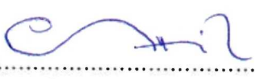
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INTRODUCTION

Food additives are used to enhance the storage life of foodstuffs and their appearance for a long time. The evolution of mass food production went hand in hand with the industrialization and the social changes at the end of the nineteenth and at the beginning of the twentieth centuries. The first invented and expansively applied food additives were the artificial preservatives, later due to innovators newer and newer additives appeared and their utilization became more and more widespread. In line with the spreading of their application – according to the given period's requirements – the actual authorities always paid great attention on the health effects of food additives as well as on their traceability and on their monitoring.

Due to the changing lifestyles (e.g. running lifestyle, spreading of ready-to-eat and conventional foods) domestic food production and preservation is continuously surpassed, and at the same time the importance of foodstuffs produced by the industry is marked up. Food industry has to fulfil multiple consumer demands. Food industry has to put various, convenient, attractive and affordable foodstuffs on the shelves, and at the same time the consumers' needs for healthy, chemical free and safe products have to be satisfied, too. The food additives are one of the solutions to meet consumers' complex and often conflicting requirements. These additives influence the attributes of the foodstuffs favourably, facilitate the processing of the raw materials, improve the quality of food products and prolong their shelf life (SOHÁRNÉ, 2005).

In spite of the rigorous legal regulations more and more conscious consumers are worry about their widespread application (EUROBAROMETER, 2006, 2010) and about their safety. The possible negative health effect of certain additives is common talk, too. Beyond the worry about the food safety, damning of the application of food additives by the consumers and the media who are searching for sensation and disproportionately enhance the drawbacks and the negative factors became fashionable. Furthermore consumers' mistrust is increased by the fact that in case of some producer and product application of food additives can be query, which is confirmed by the continuous refinement of the regulation (1333/2008/EC), too.

Recognition of consumers' risk perception about food additives, as well as exploration and understanding of the underlying thoughts and the hidden motivations, have an outstanding importance in the appointment of both the effective consumer communication ways and the directions of the producers' product development.

OBJECTIVES

The main objective of my doctoral dissertation was to analyse different countries consumers' (Hungary, Spain and Romania) risk perception regarding food additives. This was achieved by the following subtasks and the related hypotheses:

- **I have considered as an aim to explore the consumers' knowledge of the analysed countries (e.g. connection of additives and 'E-numbers', regulation of their application) regarding food additives.**
 1. *Hypothesis: Level of knowledge about food additives is different in the analysed three countries.*
 2. *Hypothesis: Consumers do not know the exact connection between food additives and 'E-numbers'.*
- **On the basis of my secondary research, Hungarian and Romanian consumers associate similarly high level of worry to food additives, while Spanish ones lower.**
 3. *Hypothesis: Hungarian and Romanian respondents perceive high level of worry against food additives, while Spanish ones lower.*
- **According to the literature overview, risk perception of food additives shows socio-demographic differences. Thus, towards the targeted consumer communication I have objected the identification of socio-demographic groups having different attitude.**
 4. *Hypothesis: From the point of view of risk perception of food additives, the following consumer groups can be deemed as less sensitive: man, youngsters, high educated people, households with few children, as well as the well-off consumers.*
- **One way of the trust improvement against the utilization of food additives is to prove plain and accurate information. Thus, I consider the analysis of the effect of the information about the application of food additives towards the decreasing of the level of the perceived risk to be an important topic.**
 5. *Hypothesis: Providing information has a positive effect on the acceptance of food additives.*
- **From the consumer trends related to food additives, spreading of additive free foodstuffs and those ones containing natural components can be unambiguously highlighted. The hypothesis for the analysis of this topic is the following:**
 6. *Hypothesis: Acceptance of natural food additives is uniformly more favourable than the acceptance of artificial ones.*
- **I have set as an aim to develop a model for the identification of the factors affecting the avoidance of food additives in the analysed three countries. The models identify the differences between the countries, as well as the strength of the affects. Thus, they give an**

opportunity to influence the consumers' reactions in the direction of the avoidance of food additives.

7. Hypothesis: Strength of factors affecting the avoidance of food additives (knowledge, perceived level of risk, judgement of the health risk, trust level concerning the application) are different in the analysed three countries.

– In order to analyse the actual trends in case of food additives I have aimed to analyse the consumers' willingness to buy and willingness to pay for foodstuffs having favourable additive composition (additive free or containing natural additives).

8. Hypothesis: Remarkable willingness to pay can be observed in case of foodstuffs having favourable additive composition (additive free or containing natural additives) in the analysed three countries.

9. Hypothesis: Product characteristics (additive content, price) influence the respondents' shopping decisions differently in the three analysed countries.

– A methodological comparison of the results of the two conjoint analysis methods (rating - and choice based) utilized during my research work.

– Finally, I have aimed to synthesize the results of the research on the basis of the analysis of the hypothesis, to draw conclusions based on them, and to develop recommendations for the practice.

MATERIALS AND METHODS

To analyse the hypothesis two kinds of quantitative studies were done. The aim of the questionnaire survey was to explore consumers' opinions and knowledge regarding food additives, while the conjoint analysis was done in order to analyse consumers' willingness to buy and their preference in case of foodstuffs containing natural and artificial additives.

During the questionnaire survey in Hungary 437 (summer/spring 2011), in Spain 348 (summer/autumn 2011) and in Romania 386 (autumn 2011/winter 2012) valid questionnaires were collected via Internet. Data were analysed with the help of the SPSS 17.0 statistical software. For the data analysis univariate analysis (mean, ANOVA, Post Hoc test, t-test, standard deviation, frequency) and multivariate analysis (crosstab, two samples and independent sample t-test, cluster analysis (K-means method), principle component and factor analysis, as well as multidimensional scaling) were applied.

On the basis of the results of the questionnaire survey, three factors were chosen for the conjoint analysis: 'preservatives' (natural/artificial), 'packaging gases' (presence/absence) and 'price' (average+10%/average+20%). Average prices were determined on the basis of market data collected in the analysed countries. The conjoint analysis was done in case of two foodstuffs: pre-packed sliced cheese and chips. Utilization of the two foodstuffs is explained by the fact that the nature of the foodstuffs can influence the consumers' queries regarding food additives. According to the consumers, cheese is expected to be a 'healthier' low additive content foodstuff, while the chips not (SZÜCS and BÁNÁTI, 2010; TARNAVÖLYGYI, 2009). For the conjoint analysis six cards were chosen, and one more for the illustration of the 'standard' foodstuff (containing artificial preservatives and packaging gases on average price). In order to avoid the influence of the chosen foodstuffs (positive or negative affects from the nature of the foodstuff), the data collection were done with the help of two product order (pre-packed sliced cheese than chips cards and reverse order).

Formation of the conjoint analysis gave the opportunity for the rating - and the choice based data collection, too. Results of the previous one were analysed with the help of the Conjoint module of the SPSS statistical software (taken into consideration the main effects), while the latter one with the Conjoint module from XLSTAT statistical software (multinomial logit model). From the data collected via Internet for the rating based analysis – contracted the results of the cheese and the chips – in Hungary 250 (autumn 2011/winter 2012), in Spain 211 (autumn 2011/winter 2012) and in Romania 248 (winter/spring 2012) valid questionnaires were collected. In case of choice based analysis – separately for cheese and chips – in Hungary 216 and 210 (cheese/chips), in Spain 154 and 157, while in Romania 133 and 101 questionnaires were used.

For the linguistic equivalence of the questionnaires, the translations were conducted by professionals not participating in the actual project work. There was also a 'back-translation' process done by different independent professionals in order to provide the best possible terminologies in all used languages. Having looked at sentences and terms causing interpretation problems they were modified. For the prompt understanding of the questions a pre-inquiry was done with respondents from the analysed countries. The study and the data collection were supported by the colleagues of the IRTA (*Recerca I Tecnologia Agroalimentàries*) in Monnells, Spain, and of the UMF (*Universitatea de Medicină Farmacie Tîrgu Mureş*) in Tîrgu Mureş, Romania.

Socio-demographic distributions of the samples of the questionnaire survey and the conjoint analysis (rating - and choice based) – even though different respondents participated in the studies – showed similar features. In point of gender, females were in majority in all three countries. In Hungary and in Romania respondents between 18 and 44 years, while in Spain the 25-44 years old participants were in a higher rate. Regarding the place of residence, inhabitants of big cities had a higher rate in the samples of the analysed countries than inhabitants from small cities and villages. Most of the respondents lived with their family members. According to the highest qualifications, higher educated participants were in majority in the samples. Most of the respondents thought to have average financial circumstances.

NEW SCIENTIFIC RESULTS

Thesis 1.

Setting out from the European surveys, I have widely analysed the Hungarian, Spanish and the Romanian consumers' risk perception concerning food additives and I pointed out its detailed differences (knowledge of the concept of additives and 'E-numbers', subjective risk perception of certain additives in the system of food safety risk factors, trust felt again producers and authorities in reference to the regulation and application of food additives) and identities (preference of natural substances).

Results of the questionnaire survey verified that the respondents' knowledge was different in the participated three countries. On the basis of the 'yes or no questions' it can be said that Hungarian and Romanian participants thought to have higher level of knowledge than the Spanish respondents. However, the statements analysing the exact knowledge showed that participants overestimated their previous level of knowledge ('yes or no questions'). Participants from Hungary (61.8%) and Romania (66.8%) answered correctly in the highest rate the statement that 'Every food additives can be linked to an 'E-number', while Spanish ones answered the less correctly (39.4%)

In the course of my analysis in the three countries, I concluded that participants felt risk factors independent from additives more hazardous for their health than the food additives themselves separately or even in their groups. Hungarian participants judged the 'chemical substances from environmental pollution' as the most hazardous factor, while Spanish and Romanian ones the 'chemical residues (e.g. pesticides) migrating from agricultural raw materials into the products'. An additional difference was that the Romanian participants reported higher level of risk in case of food additives and their groups among the listed risk factors, than respondents of the two other countries.

Results draw the attention to the fact that Romanian participants were mistrustful and suspicious of producers and controlling authorities. They believed that food additives are not safe, not even at the legally authorized level utilized by the food industry. Additives are unnecessary ingredients during the food production and they consider that producers can apply additives, which are not permitted. As a result of the latter, Romanian participants are dissatisfied with the label information and think that this information is not in accordance with the facts. In contrast to the Romanian participants, Spanish ones showed trust for the producers and controlling authorities, too. Results of the Hungarian participants were between the Romanian and the Spanish judgement, however, their mistrust concerning producers was identified, too.

Analysing the judgement of 'natural' and 'artificial' additive groups it was obvious that respondents of the participated countries better accepted the food industrial utilization of 'natural'

additives. They did not make significant differences among the acceptance of ‘artificial’ groups, thus they were uniformly rather rejected. Consumers’ reference of ‘natural’ additives was confirmed by the results of the conjoint analysis (rating - and choice based), too.

Thesis 2.

In the course of my questionnaire survey – in case of many groups of food additives, as well as natural and artificial substances – it was possible to demonstrate the favourable effect of the provided information about food additives with the help of the Hungarian and the Romanian samples. Favourable changes regarding the acceptance of additives after the provided information were just partly found in Spain.

On the basis of the risk analysis of the groups of food additives – before providing information – it could be stated that all respondents from the three countries felt ‘antioxidants’ to be the less hazardous on their health. However, the favourable judgement of ‘antioxidants’ later – after providing information – turned out that it was probably due to the fact that respondents confused this food additive group with the today popular healthy food components. In Hungary the ‘preservatives’, in Spain the ‘bulking agents’ and in Romania the ‘colourings’ were judged as the most hazardous additive group, before providing relevant information about them.

According to the comparison between the countries, it can be said that the Romanian participants linked the highest level of hazard to most of the additive groups, furthermore they took the biggest differences between the judgements, while the Spanish ones the least.

After the provided relevant information (short definitions), the Hungarian and the Romanian respondents mostly accepted the food industrial utilization of ‘natural antioxidants’, while Spanish ones of the ‘natural colourings’. The Hungarian and the Romanian participants strongly rejected also the utilization of ‘artificial colourings’ after the provided information, while Spanish respondents the application of the ‘bulking agents’.

Results verified that after the provided relevant information for the Hungarian and the Romanian participants the industrial utilization of the listed groups of food additives were acceptable – except the ‘natural and artificial antioxidants’ –, while for the Spanish ones not in all cases. They did not make significant differences between the acceptances of the ‘artificial’ additives, that is because they rather uniformly rejected them.

Results of the questionnaire survey confirmed the divergent effect of the information providing in case of the analysed countries. Regarding the comparison of the countries, it can be stated that Spanish participants were more dismissive in case of the utilization of the groups of food additives than the respondents from the other two countries, as well as they made the biggest differences in their judgements.

Thesis 3.

I have developed and validated first the model of the factors affecting the avoidance of food additives on the basis of the results of my questionnaire survey. The presence of the factors of the model (knowledge, judgement of the risk and perceived health risk of food additives, trust against processors and controlling authorities) and their connections were supported by the literature references from other fields of the risk perception. The created models pointed out the differences between the countries. At the same time, it has also been confirmed that the avoidance of food additives (action) can be modelled identically; however, it can be influenced by different measures based on the country specific features related to the examined question.

Based on the overview of the literature and on my professional experience a theoretical model of the avoidance of food additives was developed (Figure 1). It is validated by pathway analysis conducted with the help of principle components (data reduction method) created from the results of the questionnaire survey.

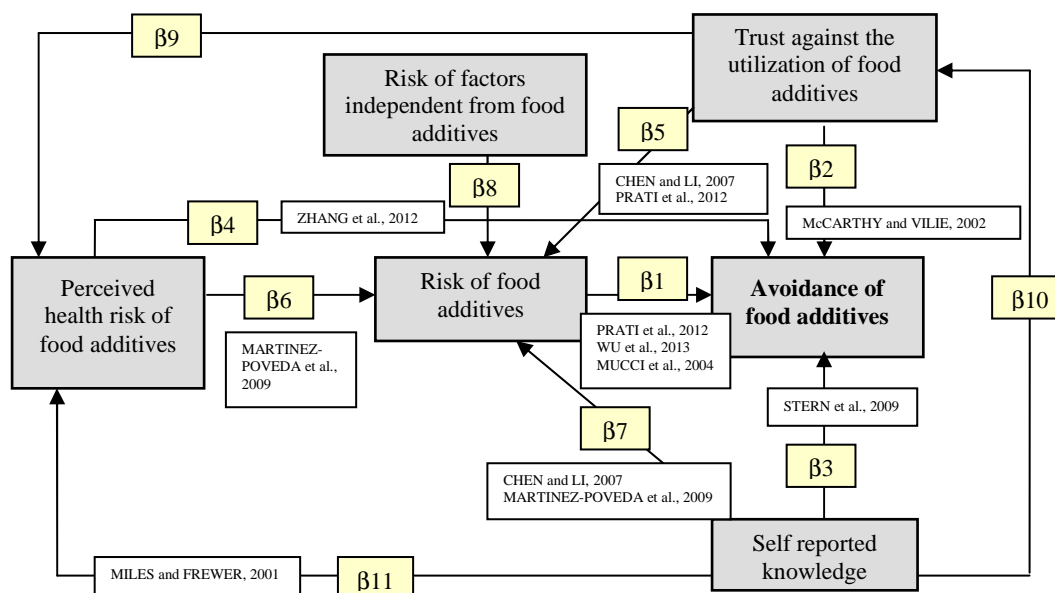


Figure 1. The theoretical model of the avoidance of food additives

Source: Own editing, 2013

The explanatory power of the created models of all three countries is high (Figure 2, 3, 4). According to the direct ways, it can be stated that in Hungary the ‘trust against the utilization’ (top-down attitude formation), in Spain the ‘perceived health risk’, while in Romania the ‘self reported knowledge’ (bottom-up attitude formation) have the strongest effect on the consumers’ actions towards the ‘avoidance of food additives’. In the Hungarian model, all of the dependent factors have direct effect on the ‘avoidance of food additives’, while in the Spanish one the ‘trust against the utilization’ and in the Romanian the ‘risk of food additives’ does not. In case of the analysed

countries, it can be stated that the rising level of ‘knowledge’ improves the ‘trust’ concerning the producers and authorities, which decreases the ‘perceived health risk’ and thus the judged ‘risk’ as well as the consumers’ actions towards the ‘avoidance of food additives’. Connections between the factors of the developed models verified the conclusions of several studies (MARTINEZ-POVEDA et al. 2009; McCARTHY and VILIE, 2002; STERN et al., 2009; ZHANG et al, 2012).

In order to explore the directly not perceptible connections and for the creation of homogenous consumer groups a cluster analysis (K-means cluster) was done with the help of the principle components. This has resulted three significantly different groups, respectively. In the analysed countries most of the participants belongs to the cluster of ‘mistrustful risk-avoiders’, whose shopping actions towards the ‘avoidance of additives’ can be formed with the top-down (trust based) attitude formation. In case of the Hungarian and the Romanian samples the bottom-up (knowledge based) attitude formation can be effective concerning the cluster of the ‘uninformed optimistics’, while in Spain for the members of the ‘acceptors’.

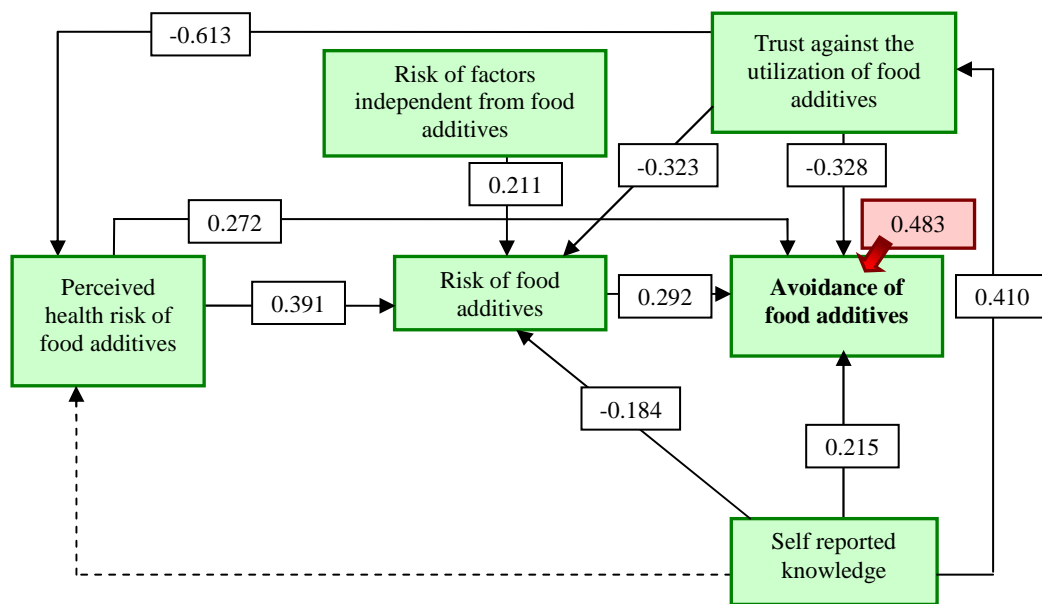


Figure 2. Factors affecting the avoidance of food additives in Hungary

Source: Own research, 2011

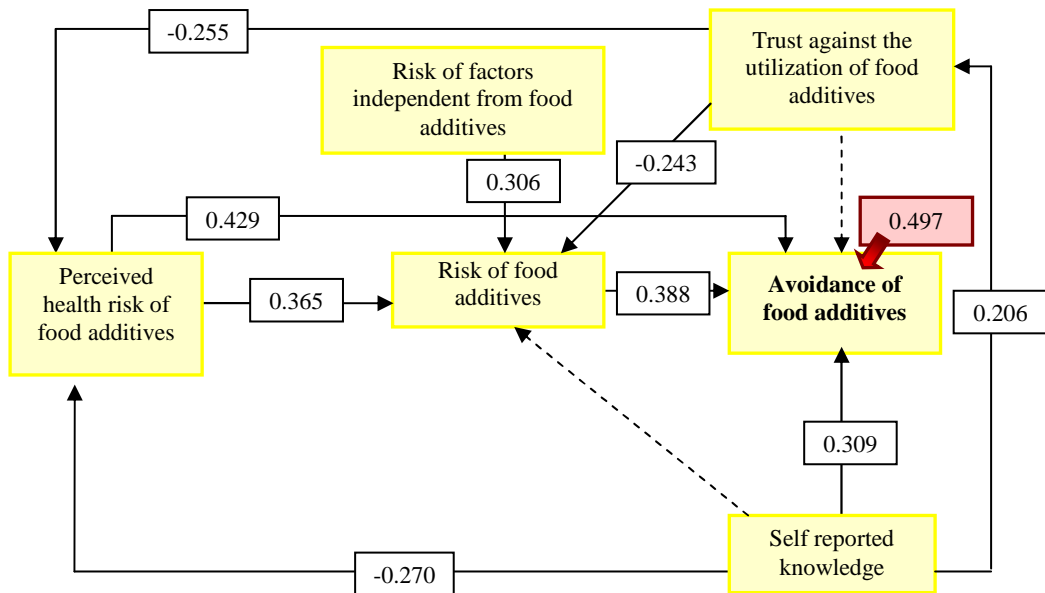


Figure 3. Factors affecting the avoidance of food additives in Spain

Source: Own research, 2011

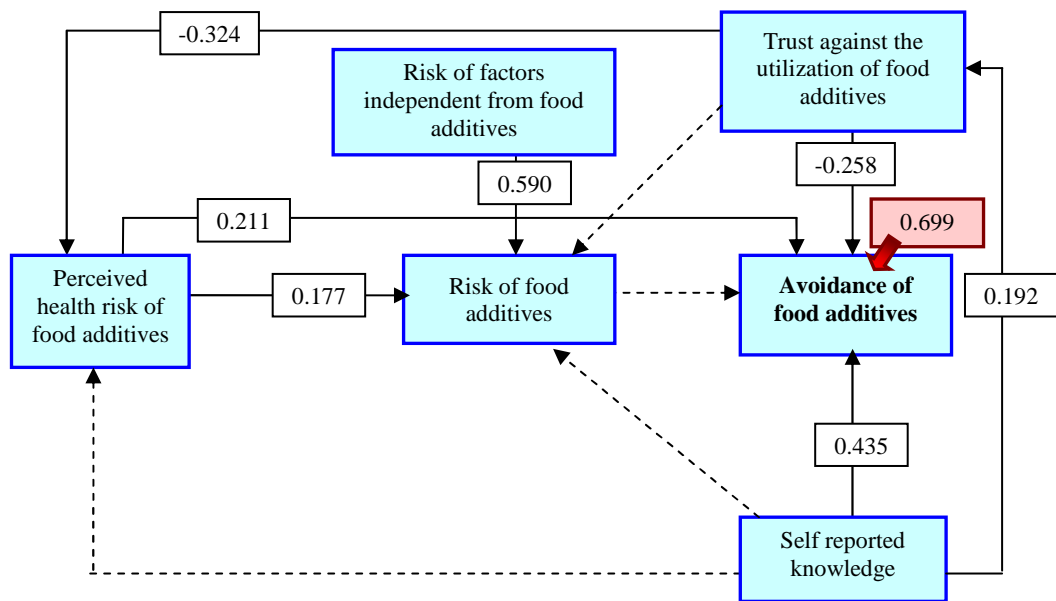


Figure 4. Factors affecting the avoidance of food additives in Romania

Source: Own research, 2011-2012

Thesis 4.

In the course of the conjoint analysis I have analysed first the Hungarian, Spanish and the Romanian consumers' willingness to buy related to foodstuffs with additive content. It can be stated as a general conclusion, that from the different levels of the product characteristics involved in the study, it was the 'natural preservatives', which affected most favourable the consumers' buying decisions concerning the analysed foodstuffs.

On the basis of the utility values resulted by the rating based conjoint analysis, it can be stated that the 'natural preservatives' had the strongest effect on the participants' shopping decisions in these countries. Besides this, the presence of 'packaging gases' was also an important influencing factor in Spain. The absence of the 'packaging gases' was perceived as a positive attribute only by the Hungarian participants. The relative importance values pointed out, that in case of the analysed countries 'preservatives' was the most important product characteristic. However, for the Spanish participants – mainly in case of chips – the 'packaging gases' was also an important attribute. Rising of the price resulted negative willingness to buy the concerned product in these countries.

According to the cluster analysis conducted with the help of the utility values it can be said that the group of 'long for naturals' are present in all these three countries. These consumers prefer foodstuffs with 'natural preservatives', however, they do not show willingness to pay extra money for these products. Furthermore, the cluster of the 'convenient' customers can be also noted in these three countries. The products containing 'packaging gases' are highly important for these participants. Especially the easy to handle feature and the practical product attributes are very attractive for them. On the basis of the created clusters it can be said that new information can have effect on the participants of the 'ambitious' cluster.

Summing up the results of the choice based conjoint analysis, it can be said that 'natural preservatives' had an outstanding positive utility during the choosing decisions of the respondents, as well as the presence of 'packaging gases' appeared as a rather positive feature – except for the Hungarian chips sample. The +20% price got negative utility according to the results of the analysed countries. According to the relative importance values, it can be stated that 'preservatives' was the most important factor during the choosing decisions of both pre-packed sliced cheese and chips. 'Packaging gases' appeared as an important factor for the Hungarian and Spanish respondents' cheese choosing decisions, while in case of chips for the Spanish and Romanian participants.

Results of the questionnaire survey pointed out that most of the participants would like to buy additive free foodstuffs, even if their sensorial attributes are different from the convenient product. Furthermore these respondents showed a significant willingness to pay extra money in case of the additive free foodstuffs (mainly on +10% and +20% prices). However, the results of the conjoint studies did not verify the respondents' willingness to pay.

Thesis 5.

The conducted two conjoint analysis (rating - and choice based) unambiguously pointed out that when more than one product is analyzed (due to the different judgement of the products) the order of the evaluable products has to be determined for the participants by taking into consideration the possible product combinations, to avoid its effect on the utility values.

According to the order of the foodstuffs (pre-packed sliced cheese, chips cards and reverse order) and to their judgement concerning their food additive content (cheese favourable, chips unfavourable) demonstrable connections were showed by the results of the choice based analysis. The results verified that if the participants first met a favourable foodstuff from the point of view of additives (now cheese) – mainly in case of the Spanish and the Romanian samples – ‘natural preservatives’ got higher positive utility value and participants accepted more the presence of ‘packaging gases’ and showed higher willingness to pay on average +20% level, too.

Thesis 6.

On the basis of the restricted comparison of the rating - and choice based conjoint analysis it is stated that the choice based analysis resulted higher rate of valid questionnaires, as well as more differentiated utility and relative importance values.

The conjoint analysis gave an opportunity to compare the results of the rating - and choice based conjoint analysis. According to the comparison the following statements were done:

- Rate of the valid questionnaires were higher in case of the choice based conjoint analysis in the analysed countries.
- Analysis of the relative importance data pointed out that during the choice based analysis ‘preservatives’ got higher dominance (*prominence effect*: focusing on more important pieces of information), than in case of the rating based method.
- According to the type of the attribute (*scale compatibility effect*: focusing on information that is easier to translate into decision) the comparison of the two methods did not show consistent conclusion.
- Regarding the focusing on the levels utility values (*level focusing effect*: focusing on more important attribute level) it can be concluded that the difference between the two mostly preferred utility values was always lower in case of the rating based analysis, than in case of the choice based analysis.

CONCLUSIONS AND RECOMMENDATIONS

Regarding the analysis of the level of knowledge on the basis of the results of the questionnaire survey – in line with the results of the conjoint analysis – it turned out that respondents believed their level of knowledge to be high. However, according to the analysis of their detailed knowledge, these opinions were not supported in all cases. Hungarian participants thought their knowledge to be high, and on the basis of their detailed knowledge it was relatively true. Spanish respondents thought it to be low and it was also verified by their incomplete detailed knowledge (e.g. knowledge of the connection of additives and ‘E-numbers’). **(Hypothesis 1. accepted, Hypothesis 2. partly accepted).**

When more information is provided for the improvement of the knowledge level concerning food additives, particularities of the countries have to be taken into consideration.

Consumers distrust can be regarded as a complex phenomenon, because beyond the food industry (e.g. utilization of food additives) it extends also to the agricultural producers (pl. pesticides, presence of pathogenic mould and mycotoxins) and to the animal husbandry (e.g. antibiotics and hormones in meat and milk). Moreover, beyond the producers and processors consumers linked high level of risk to the chemical substances from environment pollution, too. On the basis of these, it can be concluded that during the gain of consumers’ trust for foodstuffs, a complex and all linked area affecting approach has to be used.

Hungarian and Romanian participants reported higher level of risk concerning food additives than the Spanish respondents (EUROBARIMETER, 2010) **(Hypothesis 3. accepted)** which can be partly due to the media news and scandals, the spreading of cheap, poor quality and full of additive the so called ‘as if’ foodstuffs, as well as the consumers’ information from the wrong sources. In case of Spain, the appearance of food additives in the media is not typical at all. Towards the rising of trust for the foodstuffs, as well as for the established consumer decisions, accurate and reliable information have to be ensured for the consumers, furthermore during their communication the authentic sources have to be pointed out. The preliminary, trust maintaining and enhanced information is recommended for the Spanish consumers, too.

In the analysed countries, concerning the participants’ socio-demographic factors as risk sensitive group identity was found only in case of the income level, and this verified the conclusions of DOSMAN and co-workers (2001). Young participants’ low risk perception was typical only for the Hungarian respondents, and it is in line with many literature results (EUROBAROMETER, 2006; FOOD STANDARDS AGENCY, 2010). The high educated consumers’ low risk perception was proved by the Spanish results (KAJANNE and PIRTTILÄ-

BACKMAN, 1999; SLOVIC et al., 1995; DOSMAN et al., 2001; EUROBAROMETER, 2006). On the basis of the results **Hypothesis 4. is partly accepted.**

Results of the questionnaire survey pointed out an important fact, that for the analysed countries, the term ‘antioxidant’ was not obvious. In order to avoid the misunderstandings and for the accurate consumer information clarification of the concepts about food additives is reasonable.

Analysing of the consumers’ acceptance of the use of food additives after having provided information pointed out that the information has to be adjusted to the peculiarities of the countries (**Hypothesis 5. partly accepted**).

According to the pathway analysis conducted with the help of the questionnaire survey results, it can be state that the consumers’ actions towards the avoidance of food additives can be favourable influenced in Hungary by the rising of the trust (top-down attitude formation) for the use (producers and authorities) (e.g. providing authentic and understandable information as it was shown by the results of the questionnaire survey), and in Spain by the decreasing of the perceived health risk (e.g. targeted communication). For the Romanian respondents, the self reported knowledge had the strongest effect on the avoidance, and this points to the fact that it is important to make shopping decisions in the possession of exact and detailed knowledge (bottom-up attitude formation) for them (**Hypothesis 7. accepted**). For the grounding of the shopping decisions towards the avoidance of food additives it is important to decrease the perceived risks and health risk of factors connected to foodstuffs, to improve the consumers’ knowledge, as well as to take into consideration the peculiarities of the concerned countries besides keeping in view the features of the target groups.

Results of the conjoint analysis showed that for the participants of the analysed countries – contrary to the ‘packaging gases’ and the ‘price’ attributes – ‘preservatives’ had the highest relative importance value. On the basis of the outstanding utility values of the ‘natural preservatives’ it can be stated that the word ‘natural’ can be a positive ‘call’ in both the preference and in the shopping decisions (in line with the results of the questionnaire survey **Hypothesis 6. accepted**). In spite of the fact that some country specific features were identified (e.g. Spanish participants’ preference for the ‘packaging gases’) extent and dominancy of these were not obvious, thus **Hypothesis 9. is partly accepted**. High willingness to pay for additive free foodstuffs pointed out by the results of the questionnaire survey was not verified by the results of the conjoint analysis (**Hypothesis 8. partly accepted**). During the determination of the price of additive free and ‘natural’ substances containing foodstuffs the producers have to be careful, because the too high price can have negative effect on the judgement of the product. The analysed judgements about foodstuffs concerning their additive content (cheese favourable, chips unfavourable) did not have significant effect on the results.

Comparison of the results of the rating - and the choice based conjoint analysis led to the conclusion that the choice based method was more understandable and easier to handle – mainly for the Romanian respondents. According to the parameters analysing the differences, it can be said that the prominence and the level focusing effects were more remarkable in case of the choice based method (verifying the findings of FISCHER and HOWKINS, 1993; VRIENS et al., 1998; as well as MOORE, 2004), while on the basis of the scale compatibility effect the two methods did not show differences. Analysis made with the two methods in case of certain factors showed differences (e.g. utility values of ‘packaging gases’), but in point of the most important attribute (‘preservatives’) and the utility value mostly influencing the shopping decisions (‘natural preservatives’) seemed to be identical and confirmed each other’s results. Results of the primer studies pointed out that the selection of the method fitting to the aim has to be taken into consideration during the planning of a research study.

Recommendations for the practice

On the basis of my research work I herewith present the following recommendations for the practical utilization:

- Starting of plain and practical examples demonstrating information is also reasonable for the enhancement of consumer trust, consciousness and level of knowledge. During this the following have to be take into account:
 - differences between the countries (information about food additives; effect of media; consumers’ knowledge level, attitude and risk perception);
 - the socio-demographic features in the given country;
 - in case of the targeted communication (e.g. gender, age) the application of the sources thought to be authentic (SZŰCS et al., 2010; SZAKÁLY, 2011).

Furthermore, during the information of consumers, it is important to call the consumers’ attention to the risks of the one-sided food consumption.

- In the course of the new product planning and the re-planning of current products it has to be taken into consideration that ‘natural’ is a positive ‘call’ for the consumers, and this can influence the shopping decisions favourably. In case of foodstuffs favourable for the consumers according to their additive content (additive free or contains natural substances) during the determination of market price, it is recommended to use maximum 10% premium compared to the average price. Towards the decreasing of the negative consumer opinions about food additives, review of the rate of their application considering the supply chain is reasonable.
- During the research studies aimed at the analysis of willingness to pay and buy a certain product, to avoid the bias of the results of the judgement of the foodstuffs (from the point of

view of the additive content is positive or negative), and if the study extends on more than one products, the order of them have to be taken into account very carefully. Selection of the conjoint analysis method has to be planned also carefully and the foodstuffs taken into the study have to be considered thoroughly.

Further research tasks

- In spite of the fact that the explanatory power of the developed models was high identification of the effects outside of the model can hide further valuable information. Accordingly, it is important to analyse the effects of the strength of the model in case of sensitive consumer groups (e.g. young mothers), too.
- The conjoint questionnaire contained the analysis of two foodstuffs, but involving of other products it can give useful results, in particular considering the analysis of the effect of the consumers' judgement and the order of the products.
- On the basis of the results of the conjoint analysis 'preservatives' appeared as an important factor during the consumers' shopping decision in case of both foodstuffs. Further analysis of the importance of 'preservatives' and their possible product specificities are thought to be important.
- Beside the analysed countries, the involvement of other countries (even outside of the European Union) can provide further new information, both about the model demonstrating the avoidance of food additives (e.g. enhancement of the descriptive effect of the involved principle components) and on the field of the conjoint studies (e.g. importance of the order of the foodstuffs, comparison of conjoint methods).

REFERENCES

1. CHEN, M. F., LI, H. L. (2007): The consumer's attitude toward genetically modified foods in Taiwan. *Food Quality and Preference*. 18, 662-674. p.
2. DOSMAN, D. M., ADAMOWICZ, W. L., HRUDEY, S. E. (2001): Socioeconomic determinants of health- and food safety-related risk perceptions. *Risk Analysis*. 21 (2), 307-317. p.
3. EUROBAROMETER (2006): Risk Issues. Special Eurobarometer 238. 71., 79., 128., 144-145. p. (Downloaded: 25.01.2013. http://ec.europa.eu/food/food/resources/special-eurobarometer_riskissues20060206_en.pdf)
4. EUROBAROMETER (2010): Food-related risks. Special Eurobarometer 354. 14., 22., 43-59. p. (Downloaded: 25.01.2013.) <http://www.efsa.europa.eu/en/factsheet/docs/reporten.pdf>
5. FISCHER, G. W., HAWKINS, S. A. (1993): Strategy compatibility of rating-based and choice based conjoint models. In: KARNIOUCHINA, E. V., MOORE, W., L., van der RHEE, B., VERMA, R. (2009): Issues in the use of ratings-based versus choice-based conjoint analysis in operations management research. *European Journal of Operational Research*. 197, 340-348. p.
6. FOOD STANDARDS AGENCY (2010): Biannual public attitudes tracker. 6-10. p.
7. KAJANNE, A., PIRTTILÄ-BACKMAN, A. M. (1999): Laypeople's viewpoints about the reasons for expert controversy regarding food additives. *Public Understanding of Science*. 8, 303-315. p.
8. MARTINEZ-POVEDA, A., MOLLA, BAUZA M. B., del CAMPO GOMIS, F. J. MARTINEZ, L. M. C. (2009): Consumer-perceived risk model for the introduction of genetically modified food in Spain. *Food Policy*. 34, 519-528. p.
9. McCARTHY, M., VILIE S. (2002): Irish consumer acceptance of the use of gene technology on food production. 176-188. p. In: Trienkens J.H., OMTA, S.W.F. (eds.): Paradoxes in food chains and networks Proceedings of the Fifth International Conference on Chain and Network Management in Agribusiness and the Food Industry, Noordwijk, Netherlands, 6-8 June 2002.
10. MILES, S., FREWER, L. J. (2001): Investigating specific concerns about different food hazards. *Food Quality and Preference*. 12, 47-61. p.
11. MOORE, W. L. (2004): A cross-vaildity comparison of rating-based and choice-based conjoint analysis models. *International Journal of Research in Marketing*. 21, 299-312. p.
12. MUCCI, A., HOUGH, G., ZILIANI, C. (2004): Factors that influence purchase intent and perceptions of genetically modified foods among Argentine consumers. *Food Quality and Preference*. 15 (6), 559-567. p.

13. PRATI, G., PIETRANOTI, L., ZANI, B. (2012): The prediction of intention to consume genetically modified food: Test of an integrated psychosocial model. *Food Quality and Preference*. 25, 163-170. p.
14. SLOVIC, P., MALMFORS, T., KREWSKI, D., MERTZ, C. K., NEIL, N., BARTLETT, S. (1995): Intuitive toxicology. II. expert and lay judgements of chemical risks in Canada. *Risk Analysis*. 15 (6), 661-675. p.
15. SOHÁR, PNÉ (2005): Az élelmiszer adalékanyagok alkalmazásának előnyei és kockázatai. *Gyógyszerészet*. 49, 745-750. p.
16. STERN, T., HAAS, R., MEIXNER, O. (2009): Consumer acceptance of wood-based food additives. *British Food Journal*. 111(2), 179-195. p.
17. SZAKÁLY, Z. (2011): Táplálkozás-marketing. Budapest: Mezőgazda Kiadó. 68-70. p.
18. SZŰCS, V., BÁNÁTI, D. (2010): Consumer knowledge and judgement of food additives in Hungary on the basis of questionnaire survey. 7th International Conference of PhD Students. Miskolc, Hungary. 8-12 August, 2010. 41-46. p.
19. SZŰCS, V., BÁNÁTI, D., SZABÓ, E. (2010): A fogyasztók omega-3 zsírsavakkal kapcsolatos ismeretei kérdőíves felmérés alapján. XXXV. Táplálkozástudományi Társaság Vándorgyűlése, Balatonőszöd. 2010. szeptember 30. - október 2. 48. p.
20. TARNAVÖLGYI, G. (2009): Az élelmiszer-adalékanyagok szakmai és fogyasztói megítélése. Doktori disszertáció. 103-105. p.
21. VRIENS, M. OPPEWAL, H., WEDEL, M. (1998): Rating-based versus choice-based latent class conjoint models: An empirical comparison. In: KARNIOUCHINA, E. V., MOORE, W., L., van der RHEE, B., VERMA, R. (2009): Issues in the use of ratings-based versus choice-based conjoint analysis in operations management research. *European Journal of Operational Research*. 197, 340-348. p.
22. WU, L., ZHONG, Y., SHAN, L., QIN, W. (2013): Public risk perception of food additives and food scares. The case in Suzhou, China. *Appetite*. 70, 90-98. p.
23. ZHANG, L., TAN, W., XU, Y., TAN, G. (2012). Dimensions of consumers' perceived risk and their influences on online consumers' purchasing behaviour. *Communications in Information Science and Management Engineering*. 2 (7), 8-14.

Corporate author reference

Regulation (EC) No **1333/2008** of the European Parliament and of the Council of 16 December 2008 on food additives. *Official Journal of the European Union*. L354, 16-33.

PUBLICATIONS OF THE AUTHOR IN THE TOPIC OF THE DISSERTATION

Articles in IF periodicals

Szűcs, V., Guerrero, L., Claret, A., Tarcea, M., Szabó, E., Bánáti, D., (2014): Food additives and consumer preferences: A cross-cultural choice based conjoint analysis. *Acta Alimentaria*. (accepted). [IF 0.475]

Article in English periodical

Szűcs, V., Szabó, E., Guerrero, L., Claret, A., Tarcea, M., Szavuj, J., Bánáti, D. (2012): Effect of information on the risk perception of food additives – A quantitative survey in Hungary, Spain and Romania. *Analecta Technica Szegediensia*. 3-4. pp. 153-158.

Articles in Hungarian periodicals

Szűcs, V., Szabó, E., Bánáti, D. (2010): Az adalékanyagok fogyasztói megítélése I. (Consumer judgement of food additives I.) *Élelmiszer Tudomány Technológia*. LXIV., 1. pp. 15-19.

Szűcs, V., Szabó, E., Bánáti, D. (2010): Az adalékanyagok fogyasztói megítélése II. (Consumer judgement of food additives II.) *Élelmiszer Tudomány Technológia*. LXIV., 2. pp. 20-24.

Szűcs, V., Szabó, E., Székely, N., Bánáti, D. (2012): Egyetemisták élelmiszer-fogyasztása az adalékanyag-kitettség becslésének felmérése tükrében. (Food consumption of university students from the point of view of additive exposure assessment) *Új Diéta.*, 5-6. pp. 20-23.

Szűcs, V., Bánáti, D. (2013): Trendek az élelmiszer-ipari adalékanyagok felhasználásában. (Trends in the utilization of food additives) *Orvosi Hetilap*. 154., 46. pp. 1813-1819.

Article in other periodical (in English)

V., Szűcs, D., Bánáti (2010): Risk perception of food additives in Hungary. *Analecta Technica Szegediensia*. 2-3. pp. 243-247.

Conference proceedings (full paper in Hungarian language)

Szűcs, V., Szabó, E., Claret, A., Guerrero, L., Tarcea, M., Szavuj, J., Bánáti, D. (2012): Élelmiszeripari kockázati tényezőkkel kapcsolatos fogyasztói attitűdök, különös tekintettel az adalékanyagokra – magyar, spanyol és román kvantitatív felmérés eredményei. (Consumer attitudes regarding risk factors connected to foodstuffs in view of food additives – results of a quantitative survey in Hungary, Spain and Romania) II. Magyar Világtalálkozó keretében megrendezett Nemzetközi Tudományos 3. Báthory – Brassai Konferencia, Budapest. 2012. július 5-6. pp. 63-69.

Conference proceedings (abstract in Hungarian language)

Szűcs, V., Szabó, E., Guerrero, L., Claret, A., Bánáti, D. (2011): Adalékanyagok megítélésének összehasonlítása magyar és spanyol kérdőíves megkérdezés alapján. (Comparison of the judgement

of food additives on the basis of the results of a Hungarian and a Spanish questionnaire survey) XXXVI. Táplálkozástudományi Társaság Vándorgyűlése, Balatonőszöd. 2011. október 6-8. pp. 52.

Szűcs, V., Bánáti, D., Claret, A., Guerrero, L. (2012): Vásárlási hajlandóság vizsgálata az élelmiszeripari adalékanyagok tükrében - Conjoint vizsgálat magyar és spanyol fogyasztók körében. (Analysis of willingness to buy from the point of view of food additives – Conjoint analysis among Hungarian and Spanish consumers) Táplálkozástudományi Kutatások II: Innováció - Táplálkozás - Egészség – Marketing, Kaposvár. 2012. december 10-11. pp. 10.

Szűcs, V., Szabó, E., Bánáti, D. (2013): A FACET projekt keretében kifejlesztett szoftver az adalékanyag kitettség becslésben. (Software for the assessment of food additive exposure developed in the frame of the FACET project) Hungalimentaria 2013, „Kockázatbecslés, önellenőrzés, élelmiszerbiztonság” tudományos konferencia és szakmai kiállítás. 2013. április 16-17. pp. 62-63.

International conference proceedings (full paper in English language)

Szűcs, V., Bánáti, D., Szabó, E. (2008): Relationship between the structure of the meat product consumption and the food additive exposure. International Conference on Science and Technique in Agri-Food Business. Szeged. Magyarország. 5-6. November, 2008. pp. 430-435.

Szűcs, V., Bánáti, D. (2010): Consumer knowledge and judgement of food additives in Hungary on the basis of questionnaire survey. 7th International Conference of PhD Students. Miskolc, Hungary. 8-12. August, 2010. pp. 41-46.

Szűcs, V., Szabó, E., Tarcea, M., Szavuj, J., Claret, A., Guerrero, L., Bánáti, D. (2012): Knowledge and judgement of food additives in three European countries. 6th Central European Congress on Food. Novi Sad, Serbia. 23-26 May, 2012. pp. 1176-1180.

Szűcs, V., Bánáti, D., Claret, A., Guerrero L. (2012): Acceptance of food additives in Hungary and Spain: An experimental study. 6th Central European Congress on Food. Novi Sad, Serbia. 23-26. May, 2012. pp. 1170-1175.

Szűcs, V., Guerrero, L., Claret, A., Tarcea, M., Szabó, E., Bánáti, D. (2013): Analysis of consumer preferences related to food additives in Hungary, Spain and Romania: Results of a choice based conjoint analysis. Food Science Conference 2013 – With research for the success of Darányi Program. Budapest, Hungary. 7-8. November, 2013. pp. 373-376.

International conference proceeding (abstract in English language)

Szűcs, V., Bánáti D. (2010): Consumer judgement of food additives in Hungary. 1st International Congress on Food Technology. Antalya, Turkey. 3-6. November, 2010. pp. 510.

Szűcs, V., Bánáti, D. (2010): Perception of food additives and their use by Hungarian consumers. European Federation of Food Science and Technology, Annual Meeting. Dublin, Ireland. 10-12. November, 2010. (CD)