



Investigating consumers' avoidance of E-numbers

November 2013
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MSc Thesis Chair Group Strategic Communication

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November 2013

MSc Applied Communication Science
Specialisation: Food & Food Law

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ACKNOWLEDGEMENT

First of all, I would like to thank my supervisors Marijn Poortvliet and Ralf Hartemink for their support and their constructive feedback. Without them, this research would not have been possible to be executed and report the way it is done now. Secondly, I would like to thank the third parties that helped me in the execution of the different studies: Jac Niessen for the press release, all persons spreading the invitation to my survey via social media and the internet, and Essensor for giving me the possibility to execute my experiment in their research centre. Finally, thank you to Dirk-Jan Huizing and my parents for their support during the whole process of this thesis.

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ABSTRACT

Previous studies have indicated that consumers are increasingly interested in food-related health risks. E-numbers tend to be avoided by consumers. Further, E-numbers are food-related issue that receives media attention on a regular basis. However, in the scientific literature research concerning the consumers' attitude specifically towards E-numbers is relatively scarce. Therefore, the present research investigates the avoidance of E-numbers by consumers and attempts to diminish this avoidance. In the research knowledge is proposed as an extension of the SPARTA model and is tested in the different studies. Studies 1 and 2 reveal that consumers have some basic knowledge about E-numbers, such as functions of E-numbers and that it is authorized, but lack knowledge about the natural presence of E-numbers in some food products. Knowledge is found to be a valid extension of the SPARTA model. As a next step, in Study 3 an experiment is performed in which additional information about E-numbers is provided to test whether this significantly increases the level of knowledge and eventually improves the attitude and intention to avoid E-numbers as well. A significant increase in knowledge level was found, but no significant changes in attitude and intention were found. Furthermore, the consumers' intention to avoid the consumption of food products containing E-numbers was found to be higher than the actual avoidance of these food products. Further research with regard to the effects of providing additional information is advised to further understand the effect. Moreover, intervention on several variables at the same time seems to be needed to eventually diminish the consumers' avoidance of food products containing E-numbers..

GLOSSARY

App	Mobile application
CBS	Centraal Bureau voor de Statistiek (Statistics Netherlands)
Consumentenbond	Dutch Consumers Union
EFSA	European Food Safety Authority
EU	European Union
FNLI	Federatie Nederlandse Levensmiddelen Industrie (Federation of the Dutch Food Industry)
FSA	Food Standards Agency
HBO/ (post) WO	Higher professional education/ University degree/ PhD
HAVO/ VWO	Higher secondary education
MAVO	Pre-secondary vocational education
MBO	Higher secondary vocational education
QR code	Quick Response Code; a type of matrix barcode that can be scanned with a mobile phone to open a URL
RIVM	National Institute for Public Health and the Environment
TPB	Theory of Planned Behaviour
Voedingscentrum	The Netherlands Nutrition Centre
WUR	Wageningen University & Research Centre

1. INTRODUCTION AND BACKGROUND

Consumers are more and more aware of the content of their food. They are increasingly interested in food-related health risks (Grunert *et al.*, 2003; Hauser *et al.*, 2011; Lobb *et al.*, 2007; Wandel, 1994). These health risks include food additives, which are gaining in importance in the consumers' concern about food safety (Tarnavölgyi, 2003). As shown in research of Cragg Ross Dawson for the Food Standards Agency (FSA), many consumers equate food additives with E-numbers (Cragg Ross Dawson, 2008). A food additive is any substance not traditionally occurring in a certain food product and which is added for a technological purpose, for example preservation or sweetening. Within the legislation of the European Union (EU), 26 "technological purposes" have been defined (EC-DG Health and Consumers, 2011). An E-number is a substance authorized for food use, which is allowed to be used as a food additive, but may occur naturally in certain foods as well. E-numbers are numbers assigned to food additives with a proposed use that is considered safe by the European Food Safety Authority (EFSA). An example to elucidate the difference between food additives and E-numbers is E300 (ascorbic acid). This may be added to a food product as an anti-oxidant by referring to it as ascorbic acid or E300. In this case, it is a food additive. However, most fruits and vegetables naturally contain ascorbic acid. For example, an apple contains E300, but in this case it is not a food additive as it is a natural substance of the food.

On online forums it becomes clear that not all consumers fully understand what E-numbers are. For example, one person posted the thought that everything not coming from a package is E-number free (Viva Forum, 2012). In the media, attention to food additives is given on a regular basis by discussing E-numbers (Haen, 2013). Examples broadcasted on Dutch television include the episode of *De Kinderen van de Keuringsdienst* regarding E120 (Keuringsdienst van Waarde, 2008) and the item on E-numbers in *TROS Radar* on 20 February 2012 (TROS Radar, 2012). As comes clear from online forums, some consumers tend to ban E-numbers from their diet. In the online forum, consumers exchange recipes and tips on where to buy E-number free food (Viva Forum, 2012; Gezondheidsnet, 2012).

Even though food additives have gone through extensive evaluations before being allowed on the European market, consumers regularly consider food additives as unnatural, artificial and bad for their health (Cragg Ross Dawson, 2008). This leads to a paradox surrounding E-numbers: even though they were introduced to inform consumers about the content of the food products they consume, some consumers associate them chemicals in food products (Haen, 2013). This is underlined in the research of Evans *et al.* (2010) on the consumers' ratings of the naturalness of foods in which was showed that when using the chemical names (or E-numbers) to describe a certain entity this entity was always perceived to be less natural compared to the use of the common names of the entity (Evans *et al.*, 2010). In The Netherlands, half of the consumers are to some extent worried about E-numbers as concluded from a survey of the Consumentenbond (2010). The same result was found in the Eurobarometer 2010 in which 56% of the respondents in The Netherlands stated they were 'worried' about the addition of colourings, preservatives or flavourings to foods or drinks. In this, the numbers of respondents stating to be "very worried" and to be "fairly worried" were combined. The Eurobarometer is performed by the European Commission to monitor the public opinion in the Member States. Even though the percentage of respondents stating to be "worried" is lower in The Netherlands compared to Europe's total score (56% versus 66%), the increase compared to the Eurobarometer of 2005 is significantly higher in The Netherlands (+16 versus +5 percentage points).

In the UK, the worry even decreased by 11 percentage points (Eurobarometer, 2010) compared to 2005, without any clear reason.

In recent years, consumers started to recognize that food additives do not only have disadvantages, but also have advantages, such as extending the shelf life of food products. However, the general assumption that additives are 'bad' remained (Brockman and Beering, 2011). To decline the worry of consumers, it is important to be aware of the determinants of food behaviour. The behaviour can be influenced by the consumers' perception of food safety while on the other hand the behaviour can influence the perception of food safety as well. Hence, researching the relation between risk perception and consumers' behaviour regarding E-numbers is important (RIVM, 2004). Further, to influence the consumers' avoiding behaviour regarding E-numbers different types of interventions are effective for different types of behavioural determinants.

Given the controversy regarding E-numbers, surprisingly little information is available in scientific literature regarding the consumers' attitude towards E-numbers. Previous studies performed were mainly related to food risks in general (Evans *et al.* 2010). Therefore, the present research contains research to the consumers' attitude and their 'perceived risk' specifically aimed at E-numbers. The goal of this research is twofold: firstly to identify the reasons behind the consumers' worries about E-numbers and secondly to test a method to change the consumers' behaviour of avoiding E-numbers.

MODELS AND THEORIES

In order to structure the first part of the research, different variables that (potentially) influence the consumers' attitude and buying behaviour regarding E-numbers need to be identified. For this, the SPARTA model (Lobb *et al.*, 2006) will be used. This model is based on the Theory of Planned Behaviour (Ajzen, 1991). In this paragraph, the two models will be compared. First, both models will be discussed one by one. Secondly, 'knowledge' will be introduced as a variable to potentially complement the SPARTA-model as the existing knowledge of consumers seemed to be influential in food-related issues (Rodríguez-Entrena and Salazar-Ordóñez, 2013; Tarnavölgyi, 2003). Finally, the relevance of the extended SPARTA-model to the topic of E-numbers will be explained.

THEORY OF PLANNED BEHAVIOUR

The Theory of Planned Behaviour (TPB) of Ajzen helps to find the underlying beliefs that define human behaviour by looking at the attitudes, subjective norms and perceived behavioural control (Ajzen, 1991). The model can be used to predict the consumers' intention to perform a specific behaviour, if this behaviour is performed intentionally. The variables that are suggested in this theory to predict the intention to perform a behaviour are attitudes, subjective norms and perceived behavioural control (Francis *et al.*, 2004).

In the attitudes is included whether a person has a favourable or an unfavourable evaluation of the behaviour in question for which two components are considered important: beliefs about the consequences of the behaviour and the corresponding judgement (either positive or negative). The subjective norm is also referred to as a social factor and includes the own estimate of a person of the social pressure to either perform or not perform the behaviour in question (Francis *et al.*, 2004; Ajzen, 1991). The perceived behavioural control is based on how easy or difficult performing the

behaviour at question is according to the person. Intention indicates the readiness of a person to perform the behaviour at question (Ajzen, 2013).

To visualize the various links between variables of the TPB, the model is shown in Figure 1. The link between attitude and intention represents the influence attitude has on the intention. Furthermore, attitude does not only influence, but is also influenced by the variables subjective norm and perceived behavioural control. Hence, the links from these two variables towards attitude are shown as well. The subjective norm and perceived behavioural control influence each other and thus a link running in both directions is included in the model. Further, they both directly influence the intention. Combined, the variables attitude, subjective norm and perceived behavioural control lead to the intention which then leads to the actual behaviour. The behaviour is also expected to be influenced by the perceived behavioural control leading to the dotted line from perceived behavioural control to behaviour.

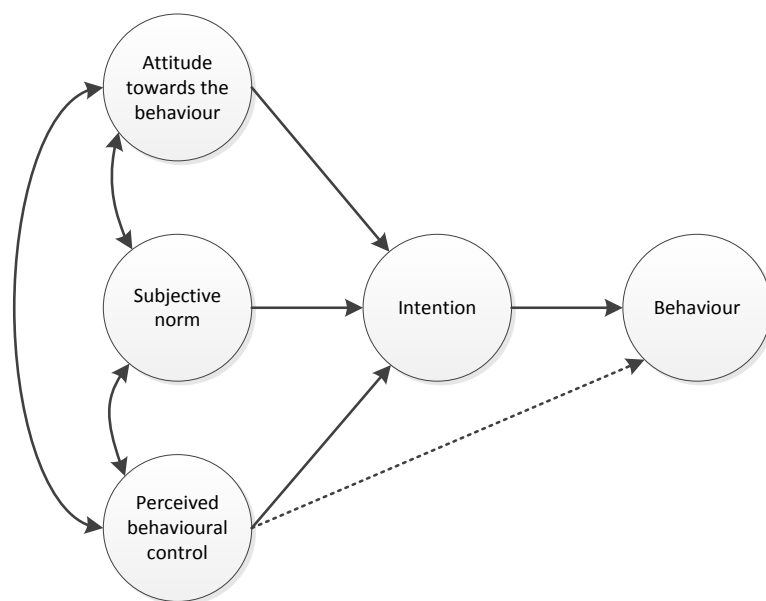


FIGURE 1 THEORY OF PLANNED BEHAVIOUR (AJZEN, 1991)

SPARTA MODEL

In the past decades several models have been developed that build further on the TPB. One of these models is the SPARTA model of Lobb *et al.* (2007) which was developed in a food-context, more specifically for “*modelling risk perception and trust in food safety information*”. This makes the extension suitable for the current research to E-numbers. In Figure 2 the model can be found. The model is based on three levels, namely the global variables that relate to the specific determinants for the intention to purchase, quantification of the level of interaction among the global variables, and the third level including the intention to purchase and demographics influencing the behavioural parameters (Lobb *et al.*, 2006). The three levels enable a simulation approach for the overall effect of a change in the trust level towards a given source of information. In the SPARTA model of Lobb *et al.* (2007), the TPB of Ajzen (1991) is extended with the variables ‘risk perception’ and ‘trust’. As stated by Lobb *et al.* (2007), risk perception does not seem to influence behavioural intentions directly. A straight line goes towards the variables ‘trust’ and ‘attitudes’. ‘Risk’ seems to negatively affect attitudes. ‘Trust’ is linked to subjective norm and intention to purchase.

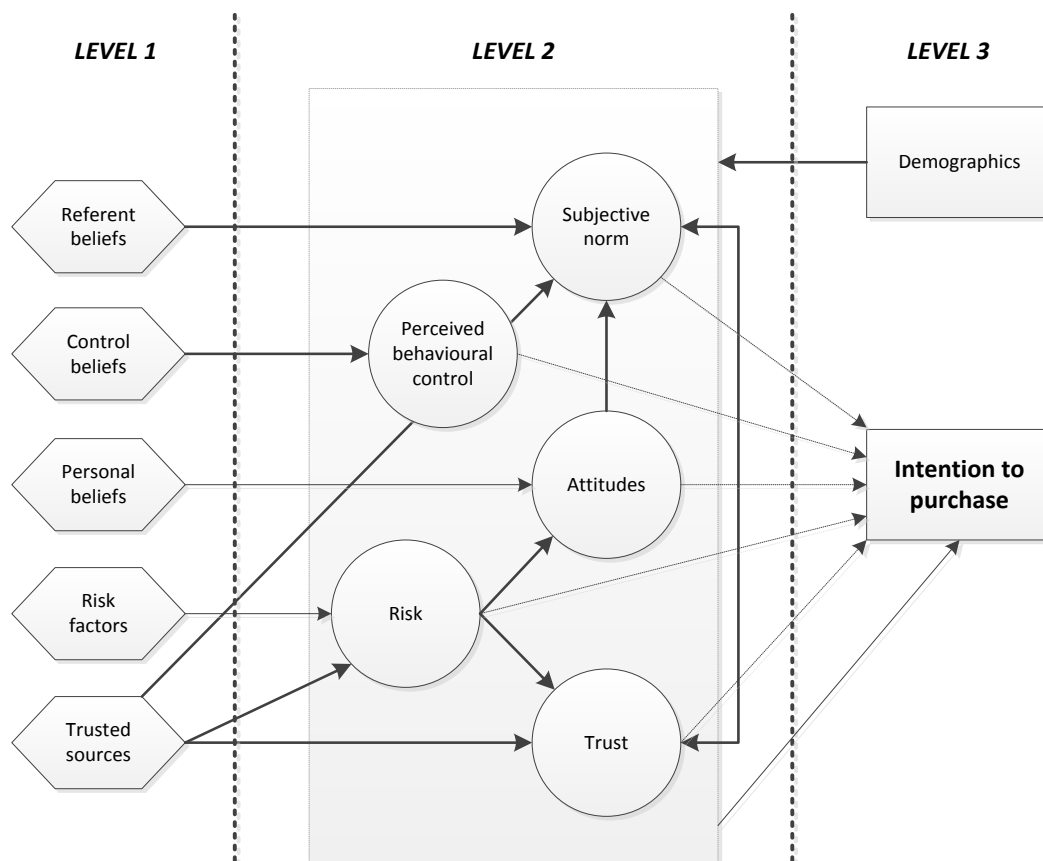


FIGURE 2 SPARTA MODEL (LOBB ET AL., 2007)

KNOWLEDGE-DEFICIT THEORY

As mentioned previously, knowledge seemed to be influential in food-related issues. The Knowledge-Deficit Theory is formed based on the importance of knowledge. The basic assumption of this theory is that *“increasing knowledge will translate into a change in behaviour”* (Schultz, 2002, p.69). Knowledge may be defined as *“facts, information and skills acquired through experience or education and the theoretical or practical understanding of a subject”* (Oxford Dictionary, 2013).

The linchpin of the Knowledge-Deficit Theory is whether knowledge causes a change in behaviour or not. In the research of Schultz related to recycling behaviour, it was shown that knowledge is a strong predictor of behaviour and is also consistent. However, as suggested in the article, this strong relationship may not be causal (Schultz, 2002). Furthermore, Schultz concluded that increasing the knowledge of people will not lead to a change in behaviour in cases where people already have a basic understanding of the topic. This is also due to the finding that a change in knowledge mostly leads to small changes in behaviour which are only present on the short-term (Schultz, 2002).

KNOWLEDGE INCLUDED IN THE SPARTA MODEL

Knowledge is not addressed in either the TPB of Ajzen (1991) or the SPARTA model of Lobb *et al.* (2007). As discussed before, in the knowledge-deficit theory, it is assumed that increasing knowledge will translate into a change in behaviour, but is not proven to be causal (Schultz, 2002). In this research, it is hypothesized that the relation between knowledge and behaviour is mediated by

attitude. The relation between knowledge and behaviour is seen as an indirect causal relationship, as shown in Figure 3.



FIGURE 3 INDIRECT CAUSAL RELATION KNOWLEDGE AND BEHAVIOUR

As Ajzen (2006) stated as a general rule that *“the more favourable the attitude and subjective norm, and the greater the perceived control, the stronger should be the person’s intention to perform the behaviour in question”* (Ajzen, 2006, p.1). Measuring all variables of the proposed model is needed not only to define the factors influencing the consumers’ intention to avoid the consumption of food products containing E-numbers, but to validate the proposed model as well. The extended model is shown in Figure 4.

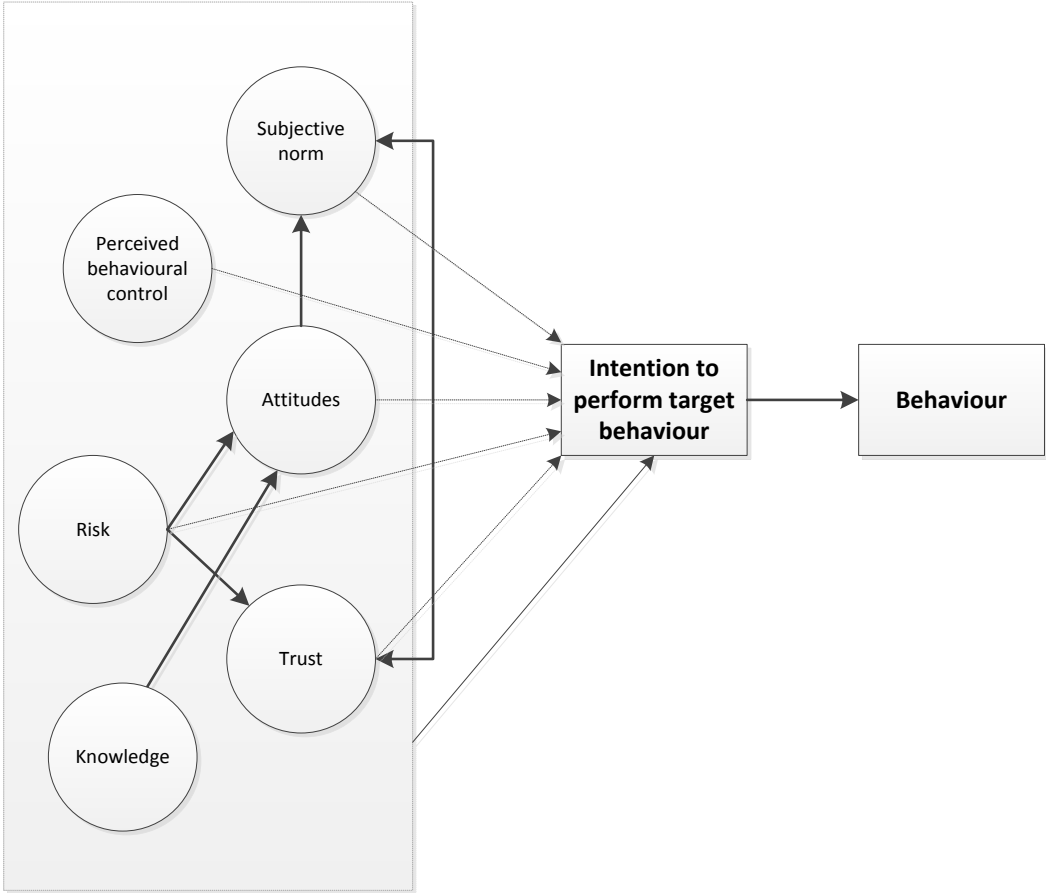


FIGURE 4 EXTENDED SPARTA MODEL

Relevance of the variables to the topic of E-numbers

The model has several links between variables. In this part the variables in relation to E-numbers are elaborated. As discussed above, knowledge seemed influential in previous food-related studies and this might be influential in relation to E-numbers as well. Attitude is highly relevant in relation to food technologies, and thus also for E-numbers. As Grunert *et al.* (2003) concluded in their research *“they form the psychological reality of consumers and may develop considerable force in the*

marketplace". The subjective norm contains the social pressure consumers might feel to either accept or reject E-numbers. As half of the Dutch consumers (Consumentenbond 2010; Eurobarometer, 2010) has some level of worry about E-numbers, the pressure of relatives might be influencing other consumers as well. Some authors mentioned that consumers have limited ability to assess food safety and thus need to rely on others, such as institutions and media (De Jonge *et al.*, 2010; Siegrist, 2008). This makes trust a relevant variable influencing the behaviour towards E-numbers as well. The distrust of consumers to E-numbers is mainly related to the idea they are chemical and bad for their health (Cragg Ross Dawson, 2008). The latter is related to the perceived risk of E-numbers and is therefore expected to be influential to the behaviour of consumers regarding E-numbers. Also unknown potential effects seem to increase the perceived risk in food-related issues (Veeman and Adamowicz, 2004). The perceived behavioural control deals with the extent to which consumers they have a choice in consuming food products containing E-numbers or not. Finally, as shown in the model, the variables are expected to lead to the intention and eventually the behaviour of consumers towards consumption of E-numbers. The complete list of hypotheses of this research are indicated in the next paragraph.

Expectations

First of all, the control variables are expected to influence the behaviour only through the other model variables (Hypothesis 1). In the Extended SPARTA-model, the newly included variable knowledge is posited to be negatively correlated with attitude (Hypothesis 2). The perceived risk is expected to negatively correlate with attitude as well (Hypothesis 3). Both knowledge and perceived risk are assumed to have an indirect causal relationship to intention, in which attitude is expected to be the mediator. The correlation between attitude and intention is expected to be positive (Hypothesis 4). Another variable with an expected negative correlation with attitude is subjective norm (Hypothesis 5). Trust is assumed to be negatively correlated to the subjective norm (Hypothesis 6), the intention (Hypothesis 7) as well as to the perceived risk (Hypothesis 8). Already some expectations of variables correlating to the intention have been indicated, but more variables are posited to correlate to the intention. The variables perceived behavioural control (Hypothesis 9), subjective norm (Hypothesis 10) and perceived risk (Hypothesis 11) are all three assumed to be positively correlated to intention. Finally, it is posited that intention is positively correlated to behaviour (Hypothesis 12).

2. SOURCES USED BY CONSUMERS

The existing knowledge of consumers concerning E-numbers that was shortly addressed before needs to originate from a source. Related to E-numbers, several sources are available for consumers. In this section, the different sources are discussed and are categorized as institutional sources, commercial sources and other sources.

INSTITUTIONAL SOURCES

One of the institutional sources consulted by consumers regarding E-numbers is the Voedingscentrum (*the Netherlands Nutrition Centre*). The Voedingscentrum provides scientific based and independent information regarding healthy food choices to consumers and are financed by government subsidies (Voedingscentrum, 2013) and explains on its website for example the different functions an E-number might have in a food product and that E-numbers are food additives approved by the EFSA. Another institutional source is the Consumentenbond (Dutch Consumer authority), which is an association without structural governmental subsidies and which is not aiming at profit (Consumentenbond, 2013). In August 2012 the Consumentenbond issued a small booklet regarding E-numbers explaining for example the reason of use of E-numbers and that these are authorized substances, as well as some remarks regarding the safety. This includes the intake of combinations of substances and E-numbers about which there is some public discussion, such as aspartame. Further, a short list of substances which cause cancer in testing animals are mentioned. For these substances, research is still in progress regarding the effect on humans (Consumentenbond, 2012). The last source included in the institutional sources is Food-Info.net, a project initiated by Wageningen University. This is a non-commercial website providing information about food and in specific about E-numbers. The information provided includes list both alphabetically and per number of all E-numbers. Per E-number, the origin, function, products in which it is used, daily intake, side effects and dietary restrictions are mentioned (Food-Info Foundation, 2013).

COMMERCIAL SOURCES

Among the commercial sources are sources from the food and hospitality industries. Some food manufacturers, retailers or restaurant chefs claim their products are E-number free in a reaction to the controversy surrounding E-numbers, directly or indirectly suggesting that food additives are unfair or unsafe. First example is the Unilever campaign 'Eerlijk is heerlijk' ('Fair is delicious') in 2008, for which a complaint was made by the Reclame Code Commissie. The complaint was that the campaign was suggestively placing E-numbers in a bad light and that the products still contained ingredients with E-numbers (Reclame Code Commissie, 2008). Even though the complaint was rejected, Unilever decided to stop the campaign. Another example is Innocent Drinks, a company that sells natural smoothies and claims that their smoothies only exist of fresh fruit, so without fragrances, flavourings, colorants, concentrated juices, sugar, water or E-numbers. On the Dutch website of the company, E-numbers are referred to as "rare E—honderdnogwatnummers" (weird E hundred-and-something-numbers) (Innocent Drinks, 2013). Further, Chef Albert Kooy of Canteen (canteen in Stenden University of Applied Sciences Leeuwarden) stated in an interview that E-numbers are equal to poison and thus he only serves food without E-numbers (GPTV, 2010). In all of the examples, in fact (artificial) food additives are evaded and not all E-numbers, as is communicated. These messages suggest to consumers that E-numbers are unfair or unsafe, and that food can easily be produced without them.

OTHER SOURCES

Other sources include some books written based on different backgrounds. The booklet that is most frequently used, and recommended by, consumers anxious about E-numbers, is written by Corinne Gouget (2007) who has no scientific background regarding the subject, but she started to worry about E-numbers when she was pregnant of her first child and came across a small booklet discussing the risks of E-numbers. Later on she started a research of two years collecting research results and consulting experts from all over the world, which was used as basis for her own booklet ranking E-numbers by using a traffic light system. Green for the E-numbers which are fine, orange for the ones that are doubtful and red for the ones to avoid (CKMP, 2011). In the Netherlands, over 100,000 copies (figures of 2011) have been sold so far and the information is now accessible via a mobile application (app) as well (VMT, 2011). Another list of E-numbers to avoid is created after re-evaluation of the list of Gouget by Medica Natura, which is part of the Centrum voor Natuurgeneeskunde (Centre for Naturopathy) in Drachten. Interestingly, the results of Gouget and Medica Natura tend to contradict each other on certain E-numbers. For example E249 (potassium nitrite) and E250 (sodium nitrite) are marked red by Gouget, whereas Medica Natura flagged these E-numbers green (Moween, 2013). Another book is written by Kamsteeg titled "E = eetbaar?" (E = edible?) including a description of what additives are, a description of reactions of hypersensitivity to certain substances and a discussion per E-number of the ones listed during the EU conference in Copenhagen (Kamsteeg, 2011). One of the most recent books about E-numbers is "De veiligheid en schadelijkheid van E-nummers", written by Van den Berg and Botermans. The book is the result of their thesis for the study Voeding en Diëtetiek (Food and Dietetics) of the Haagse Hogeschool (University of Applied Sciences) and discusses 210 national and international publications. It is announced as an independent book, even though it is commissioned by the Allergie Platform (Van den Berg and Botermans, 2013). On the internet, information about E-numbers can be found as well. One of the online sources is Wikipedia, on which quite neutral and complete information is provided.

3. PROBLEM ANALYSIS

Research has shown that the attitude and the values of consumers regarding products can predict the consumers' behaviour towards those product (Maio *et al.*, 2003). The author is interested in researching whether the attitude of consumers' towards E-numbers and their values can be used to predict the consumers' buying behaviour regarding the E-numbers.

The consumers' attitude of rejection regarding E-numbers is mainly a problem for the producers as food additives (and thus E-numbers) serve various technological purposes in the production process. Thus, for many products food additives are needed. The fact that consumers equate food additives and E-numbers makes the problem even more complicated, as E-numbers occur in natural products as well. So, for various practical reasons the producers cannot effectively meet the consumers' wish of E-number free foods and thus the problem influences the consumer as well. By wishing to eliminate E-numbers from their diet, the consumers limit their choice of food products. Here the equation of food additives and E-numbers as consumers make is important as well, as consumers in fact avoid the reference to E-numbers on their products. Further, many products free of food additives will have for example a shorter shelf life or look less attractive.

Food producers and consumers have different insights in what E-numbers are and whether or not to include E-numbers in foods. A difference between the expected risk of food additives as recognized by consumers and scientists (more specific, food scientists and toxicologists) was shown in research. The consumers scaled (1 = no risk, 5 = extensive risk) food additives as a risk of 2.68 whereas the scientists scaled it as 1.67 (Peters *et al.*, 2009). For the latter, finding the underlying thoughts and feelings of consumers based on which they build their attitude is important, as well as understanding the expert-lay discrepancy (Hansen *et al.*, 2003). This underlines the necessity of the present research as it contributes to clarifying the reasons for avoidance by consumers and eventually the development of means to diminish this avoidance. For solving this problem, an interdisciplinary approach is needed which will come forward in the combination of knowledge and theories of the fields of food science, communication science and social psychology used in this research.

STAKEHOLDER ANALYSIS

As discussed before, trust in sources is one of the variables of the proposed Extended SPARTA model and is especially important in food-related issues. Therefore, identifying stakeholders related to the avoidance of E-numbers is considered both important and helpful. Besides of the previously mentioned food producers and consumers, more stakeholders affected by and influencing the problem are important to identify as well. Not only can they be seen as stakeholders, but they can serve as an information source as well. The stakeholders are positioned using a Stakeholder Rainbow of Chevalier and Buckles (2013) of which the purpose is to "*visualize the differences between stakeholders involved in a situation or proposed action*" (Chevalier and Buckles, 2013:77). On the horizontal axis three levels of influence are indicated: low, moderate and high. The same division is used on the vertical axis to indicate the level of affect. The positioning is executed based on the author's own reasoning. The visual representation of the stakeholder analysis is to be found in Appendix A.

Below the stakeholders identified regarding the topic are listed:

1. *Food producers* - Highly affected | Moderate – high influence
For many food products additives are needed. The producers can decide the format of providing information regarding E-numbers on the label, based on which the consumers make their buying decision.
2. *Consumers* - Moderately – highly affected | High influence
As mentioned earlier, avoidance limits their food choice. However, they do not decide the composition of the food products but only the buying decision
3. *Voedingscentrum* - Moderately affected | Moderate-high influence
As source of independent information regarding healthy food choices, distrust of the information might affect the image of the Voedingscentrum. Further, they can influence the consumers as well by providing the right information regarding E-numbers.
4. *Media* - Little – moderately affected | High influence
E-numbers are only affective to the media in case it is a hot item at the moment for consumers. On the other hand, what the media publishes is often taken over by the consumers as being the truth and may confirm the consumers' opinions or make them start thinking about the topic.
5. *Universities/ Research centres* - Moderately affected | Moderate – high influence
Consumers might need additional scientific information which the universities/ research centres need to deliver. Their information is not always considered independent, therefore the influence is moderate – high.
6. *Government* – Moderately affected | Moderate – high influence
The consumers avoidance of E-numbers may lead to discussions by the government to consider changes in their policy. Both changing policies and governmental campaigns to educate consumers about E-numbers can influence the level of avoidance.
7. *Medics* – Little – moderately affected | Moderate – high influence
With medics is meant doctors and alternative health care. Medics may be asked questions about the effect of E-numbers by their patients but it is not a main component of their daily job. The information provided by medics is often trusted by consumers.
8. *Dieticians* – Moderately – high affected | High influence
Dieticians are mentioned separately from medics as dieticians typically work with their patients on food related topics, where medics deal with patients with regard to all kinds of medical issues. The quite negative attitude of consumers regarding E-numbers might lead to extra questions for dieticians. Patients consult dieticians specifically for food related topics.

PURPOSE

Purpose

Investigating and diminishing the avoidance of E-numbers by mapping the avoidance

Main research question

In what way can mapping the avoidance of E-numbers by consumers contribute to diminishing the avoidance?

Specific research questions

- What is the reason for avoidance of E-numbers by consumers?
- What is the relation between knowledge and attitude of consumers regarding E-numbers?
- What is the relation between attitude and avoiding behaviour of consumers regarding E-numbers?
- What type of intervention is effective in order to positively change the attitude and avoiding behaviour of consumers?

Additional specific research questions

To be answered in case an effective intervention is found

- What is the influence of the intervention on the consumers' attitude towards E-numbers?
- What is the influence of the intervention on the consumers' buying intention of E-numbers?

4. THE PRESENT RESEARCH

STUDY 1 – ELICITATION STUDY

The purpose of Study 1 was to reveal behavioural beliefs that are shared by the target population as was suggested in several articles (e.g., Ajzen, 2006; Francis *et al.* 2004) and contributes to the development of the survey of Study 2. Study 1 was an elicitation study among 25 participants of the same population as for the final survey. Knowing the behavioural beliefs will contribute to the accuracy of the survey as questions will be in line with the common behavioural beliefs (Francis *et al.* 2004).

METHOD

PARTICIPANTS AND DESIGN

The participants were approached via the personal network of the researcher, and in the selection the educational level and direction, the gender and the age of the potential participants were taken into account. A total of 51 e-mail invitations were sent, which resulted in 26 responses. However, in the responses all participants were high educated, mainly in the field of communication. Further, most respondents were female and in the age group 19 – 25. The total division is showed in Appendix B.

PROCEDURE

In the e-mails a link to a short written online survey was included. For all questions text boxes were included in which participants could type their answers. Participants had the opportunity to continue the survey within six days after the day they initially started the survey. The survey was closed after 5 days. The answers were exported to Excel for the analysis.

MEASURES

In order to analyse the results, per question the answers were first categorized. Then, the percentages per category were calculated to state how often a certain type of answer was provided by the participants. In case participants mentioned multiple topics in one answer, (part of) the answer was added to all relevant categories.

The questions were asked in the form of open questions which were based on the manual of Francis *et al.* (2004) and were related to the variables of the Extended SPARTA-model. These questions were followed by a general question. The questions in English are listed below, the original Dutch version can be found in Appendix C.

DEFINITION

- How would you define E-numbers?

ATTITUDE

- What do you believe are the advantages of consuming food products containing E-numbers, as part of the regular diet?
- What do you believe are the disadvantages of consuming food products containing E-numbers, as part of the regular diet?

SUBJECTIVE NORM

- Which individuals or groups who are important to you, would approve your consumption of food products containing E-numbers as part of the regular diet?
- Which individuals or groups who are important to you, would disapprove your consumption of food products containing E-numbers as part of the regular diet?

PERCEIVED BEHAVIOURAL CONTROL

- What factors or circumstances avoid you to consume food products containing E-numbers, as part of the regular diet?
- What factors or circumstances make it difficult or impossible for you to consume food products containing E-numbers, as part of the regular diet?
- Are there any other issues that come to mind when you think about consuming food products containing E-numbers, as part of the regular diet?

RISK

- Why do you think that the consumption of food products containing E-numbers as part of the regular diet might be risky?
- What do you consider the main risk of the consumption of food products containing E-numbers as part of the regular diet?

TRUST

- Which sources do you consider reliable regarding information on E-numbers?
- Which sources do you consider unreliable regarding information on E-numbers?
- Which sources do you use most often for information on E-numbers?

GENERAL

- What else comes to mind when thinking of the consumption of food products containing E-numbers?

RESULTS

DEFINITION

In this study, 47% of the participants defined E-numbers as “additions to food products” and most of them added that E-numbers contain e.g. colorants, preservatives and flavourings. In total 27% mentioned that E-numbers are additives, including 17% of the participants who stated that E-numbers are additives authorized by the EU. Further, participants notions included that E-numbers indicate artificial additives, that it is a name given to certain ingredients of food products, that E-numbers are not always natural and that it is an abbreviation of certain added substances.

The largest part of the participants could provide a clear and sound definition of E-numbers. However, the answers provided in the later questions indicated some lack of knowledge/misunderstandings. Participants prefer natural products over products containing E-numbers, which indicates that they are not aware of the presence of E-numbers in their fruits and vegetables. For example, participants answered “As I love eating pure things, I rarely eat E-numbers” and “If you have a diet that has variety and is healthy with a lot of (organic) fresh fruits and vegetables, you don’t eat a lot of E-numbers and thus I consider it to be okay”. Another response was related to health: “I think you can state that the more E-numbers in one product, the less healthy (in comparison to fresh products). Further, a participant thinks that “E-numbers sometimes negatively influence the real taste of natural ingredients”. Some participants for example stated that the meaning of E-numbers was unknown to him/her, or that he/she was unfamiliar with the number-system and how it works.

ATTITUDE

The opinion of most participants was positive towards the consumption of food products containing E-numbers as part of the regular diet: 31% stated it is fine, no problem and 15% states that it is normal and is just part of it. For 15% it depends on the E-number. Further, some participants stated that the consumption of E-numbers should be limited when possible and that it is not a huge problem, but less E-numbers seems to be better to them. Where some were neutral about E-numbers, only some were negative, existing of the participants who stated it is unnecessary and who stated it is insuperable.

The most mentioned advantage by the participants was the shelf life (33%). Further, the appearance of the product and taste (10 and 15% respectively) were often mentioned as advantage. As a participant stated: “it is easy because it tastes good anyways”. The stability and consistency of the product, the intake of substances such as extra vitamins were also mentioned by participants. An unexpected answer was that the products containing E-numbers would be cheaper. Other responses included: quality, the substance is checked and the effect is in most cases known, smell and environmental friendly. Further, it was stated that there were no advantages, and a participant mentioned to have no idea about advantages.

Disadvantages on the other hand were, according to 44% of the participants, health risks, including allergies, cancer and the unknown potential health issues. The unknown amount of intake was seen as a disadvantage by participant as well, where also unknown substances were mentioned as a disadvantage. Two times it was stated that unnatural food products are a disadvantage and two times E-numbers were considered to be unnecessary. Two surprising answers appeared: habituation

was mentioned as a clear disadvantage of E-numbers and it was stated that E-numbers have a negative influence on the real taste of natural ingredients as was mentioned before. Other responses included: effect on behaviour, you need to trust the industry, and the anxiety among consumers. Further, it was stated that there are no disadvantages and one has no idea about disadvantages.

Considering the feelings participants relate to the consumption of food products containing E-numbers as part of the regular diet, 18% stated they don't think about it or don't look at it. 21% of the participants stated to be neutral where 11% stated not to have any feeling related to it. Some of the participants had positive feelings and stated that it is normal to consume or stated it is fine. Further, participants stated that certain substances are not good or that instinctively lowering the intake of E-numbers would be better. Another statement was no direct effects were experienced. On the other hand, it was also stated by participants that they have no good feeling about the E-numbers, they feel uncertainty and feels it is unhealthy.

SUBJECTIVE NORM

Most of the participants stated that persons in their personal environment would approve their consuming of food products containing E-numbers as part of the regular diet: family (21%), friends and housemates (21%), but also fellow students. Another unexpectedly high score was that participants stated that everyone would approve the consumption (28%), or almost everyone. The other responses included: persons are neutral, I don't know what others think of it, food industry and vegans or other food-activists.

Even though most of the participants stated that persons in their personal environment would approve their consuming of food products containing E-numbers as part of the regular diet, family (16%) and friends (29%) also count for the highest scores of persons disapproving. Further, participants stated that no one (26%) or no one important to them disapproves. Others didn't know if someone really disapproves or worries about the consumption of food products containing E-numbers. Other responses included: organic farming sector, health junkies, people eating organic foods and doctors. The large percentages for everyone and no one are in line with each other. The influence of family and friends needs further investigation as it turns out to be the largest group both for approving and disapproving the consumption of food products containing E-numbers as part of the regular diet.

PERCEIVED BEHAVIOURAL CONTROL

Most of the participants (31%) said there were no factors that would keep them from consuming food products containing E-numbers. Further, 21% of the participants stated health risks as a factor that keeps them from consuming food products containing E-numbers. Other delimiting factors indicated are the participants' preference to cook their own dishes instead of ready-to-eat meals, allergies, uncertainty about the effect, news in the media, unpleasant feeling, disapproval of their parents, the availability of alternatives, price, late closing time of the organic supermarket, the image and the participants' familiarity with an E-number.

Factors that make the consumption of food products containing E-numbers as part of the regular diet difficult or impossible are not present according to 67% of the participants, including the participants that stated there are no factors due to the presence of E-numbers in everything. 14% of the factors was again health related and included allergies and intolerances, and the risk of developing cancer.

The other responses included news in the media, preferably not consuming E-numbers, the preference for pure foods, don't think about it and unfamiliarity with the system.

RISK

According to the participants, the main risk are health risks (36% mentioned this risk). 20% stated to have no idea about the risks. Intake above the ADH, unknown effects of substances, intake of unnecessary substances and estrangement of natural taste and consistency of food products. Participants also stated that the risks depends whether you have an allergy, that the dependence on others when it comes to E-numbers and ADHD behaviour. One person stated there are no risks related to E-numbers.

TRUST

The sources considered to be reliable by the participants are mainly the internet (13%), science and packaging (both 12%) and the Voedingscentrum (10%). Other sources included governmental institutions in general, the Consumentenbond, EU, NVWA, online for a/ blogs, study/ fellow students, official institutions, newspapers/ magazine and friends. One person stated to have no idea about which sources to be considered reliable and one person did not find any source reliable.

The most often mentioned sources that are considered unreliable are the food industry (32%) and the internet (35% in total). In the total score of internet are included the internet in general, specific webpages, Wikipedia and amateur blogs. Other responses included: no sources, people without food knowledge, no idea, I don't use sources, documentaries, articles of food experts, packages, friends, and family. Some participants didn't mentioned any source to be unreliable, had no idea about which sources are unreliable or don't use sources.

The sources consulted most often by the participants for information regarding E-numbers are internet based (26% in total), consisting of internet in general, Google and Food-info-net. Further, a quarter of the participants mentioned not to use sources for information regarding E-numbers. Other sources used included the Voedingscentrum, labels on food products, Google Scholar, Pubmed, Scopus, government, Consumentenbond, scientific articles, books, RIVM, semi-scientific sources, EU, relatives and media.

A general remark of one of the participants was that more recent sources are considered more reliable due to the on-going development of science. Surprisingly labels on food products are considered reliable while the food industry, who is responsible for the information on labels, is seen as the most unreliable source.

GENERAL

Not all of the participants have other aspects that come to their mind regarding the consumption of food products containing E-numbers as part of the regular diet: 44% mentioned to have no other aspects or don't know about it. Aspects that were mentioned were related to the use of E-numbers (e.g. that it is seen as needed and can currently not be prevented), health (allergies, intolerances, antibiotics), the anxiety of consumers related to E-numbers, the type of products containing E-numbers (e.g. ready-to-eat meals), knowledge regarding E-numbers, GMO and that not all E-numbers are unhealthy.

DISCUSSION

The results of Study 1 showed that most of the participants normally don't think about E-numbers and their possible effects. This was slightly contradicting to the findings of the literature study. When thinking about it, the participants mainly worried about the (potential) health effects. However, most of the consumers did not only worry, but also recognise advantages of E-numbers. Further, participants preferred natural products over products containing E-numbers. Study 1 suggested that consumers have basic knowledge about E-numbers (food additives authorized by the EU, e.g. preservatives, colorants, flavourings), but they lack knowledge regarding the (potential) health effects and the natural presence of E-numbers in certain foods. This underlined the findings of previous research as discussed in the literature study. A surprising result was that participants trusted the information on food packages, while at the same time they distrusted food producers. This was a new insight and therefore included in the survey performed in Study 2.

STUDY 2 – SURVEY

In order to test the proposed Extended SPARTA-model, an online survey was conducted. The aim of Study 2 was to measure the avoidance of E-numbers and meanwhile test the proposed Extended SPARTA-model. A survey was performed for this purpose. The questions were mainly based on Ajzen (2006) and Francis *et al.* (2004), and were adapted to the topic of E-numbers. Included items based on Study 1 were related to the trust in different sources and the used sources for which food producers and food labels were mentioned separately. Further, the finding that most participants normally did not think about E-numbers was included. To measure the knowledge, questions were included related to the presence of E-numbers in fruits and vegetables.

METHOD

PARTICIPANTS

Six hundred seventy-seven persons opened the survey, of which 374 persons answered at least 90% of the questions, which was 55.2% of the number of opened surveys. In the survey, participants had the possibility to stop after a few questions and complete the survey within 7 days after the initial moment they opened the survey. These cases were counted only once for the total of opened surveys. In the final sample group of 374 participants, 71.0% were female and most participants were in the age groups of 19-25 years (26.0%) and 31 – 40 years (25.7%). Of the participants, 64.9% indicated to have followed education on HBO/ (post) WO level and 26.7% of the total number of participants has a food related profession, for example in the production, retail or as student. Further, 76.8% of the total sample group did not follow any type of diet and 45.9% of the participants indicated to always be the one responsible for doing the groceries.

The survey was conducted in The Netherlands on a national level. An official press release of Wageningen University was spread to 350 press contacts to be published in newspapers, magazines, websites and social media. In this press release the link to the online survey was included both in text and as a QR code, which was the first ever QR code included in an official press release of Wageningen University. So, the effectiveness of adding a QR was not known yet. However, the decision to include the code was made so to lower the barrier of opening the website when reading about it in the paper version of a newspaper or magazine. An overview of the media used and the number of participants that stated to have found the survey via the different media can be found in Table 1. Three hundred seventy-three participants indicated via which source they arrived at the online survey.

Three newspapers published the press release including the QR code. Further, the message was published on two online versions of local newspapers by the researcher. Social media contributed a lot to the collection of participants for this study. On Twitter, the invitation to the survey was sent via 14 tweets to over 30,000 followers, excluding retweets. On Facebook, the message was posted by different persons on their personal pages, and it was posted in the groups of Smakelijck, E-nummers/ E-numbers, and Wageningen Student Plaza, potentially reaching a total of > 8,000 persons (excluding likes and shared messages). Three websites published the link to the survey. The link was published on the Intranet of Wageningen University as well, but was removed after one day as this was expected to potentially attract biased participants due to the large number of Food related scientists

and students of Wageningen University. E-mails were sent by the educational director of Food Science of Wageningen University, Ralf Hartemink to his network to share the invitation (the ones of whom it is known they did share this are included in Table 2) and to the Food Science students of Wageningen University to participate themselves and share the message with their relatives. The request to share the invitation for the survey with their relatives was done in order to reach a wider public. Additionally, the Federatie Nederlandse Levensmiddelen Industrie (FNLI, Federation of the Dutch Food Industry) shared the invitation with their members via e-mail. The researcher sent personal invitations to friends and family by e-mail as well.

PROCEDURE

In this survey the avoidance of E-numbers was measured besides of the testing of the proposed model. For this purpose, questions regarding the model variables were included as well as questions regarding the control variables and the information sources used by participants when searching for information concerning E-numbers. Confidentiality of the responses was assured in the introduction of the survey.

TABLE 1 MEDIA USED FOR APPROACHING PARTICIPANTS

Medium	Publications*	Participants	Examples
Twitter	14 tweets (excluding retweets)	43	Onno Kleyn, Ronald Veldhuizen, Wageningen University, Ergogenics, Stichting Voedselallergie
Facebook	14 messages (excluding likes and shared messages)	76	Smakelijk, E-nummers, Wageningen Studentplaza, personal pages
Internet	Posted on 3 websites	173	Food-Info.net, Foodlog, Blog Smakelijk
Newspaper	3x in paper version 2x in online version	3	Zaankanter (2 editions), De Krommeniër Woerdens Nieuwsblad, Stad Wageningen
Magazine	-	3	Diabc
E-mail (personal contacts)	E-mail and telephone invitations to relatives of the researcher	9	Family, friends
E-mail (other)	E-mails to students E-mails to members	30	E-mails of Ralf Hartemink to his network and Food Science students, E-mail of FNLI
Wageningen University	Posted on Intranet for 1 day	8	Intranet, WUR
Other	n.a.	28	n.a. (e.g. answered 'other source' without defining which source)

* The mentioned publications are the ones that could be traced back

MEASURES

CONTROL VARIABLES

Six questions regarding control variables were included in the survey. These were related to gender (1 = "male", 2 = "female"), age (1 = "<= 18 years", 2 = "19 -25 years", 3 = "26-30 years", 4 = "31-40 years", 5 = "41-49 years", 6 = "50-59 year", 7 = "=> 60 years) and highest attended educational level (1 = "lowest education", 2 = "MAVO", 3 = "MBO", 4 = HAVO/VWO, 5 = "HBO/ (post) WO"). Profession was added as a control variable as well, participants were requested to indicate to which category their profession belongs (food related, health related or other; all with subcategories). Another control variable used in the survey was diet. This was an open question in which participants could indicate whether they follow a diet and if so, which diet. The sixth control variable was the responsibility for doing the groceries (1 = "never", 7 = "always") and was included to control for whether this would influence the hypothesized relationships that were tested.

INFORMATION SOURCES USED WHEN SEARCHING E-NUMBER RELATED INFORMATION

One of the questions was related to the information sources used by consumers for information regarding E-numbers. The participants were asked to rank a list of 16 sources based on their importance (1 = "most important", 16 = "least important"). The list included sources in the personal network of participants, such as family, health related sources (e.g. doctor), food related sources (e.g. producers), different media (e.g. internet, newspapers) and government/ institutional sources (e.g. universities). In case an important source was not listed, participants had the option with 'other sources' to identify this source and rank the source among the list. The full list can be found in Appendix D. Even though sources are not a variable of the Extended SPARTA-model, this question was included in the survey in order to have an indication which sources are seen as important for information regarding E-numbers. Later on, the information of this question could be used for the construction of the experiment which will be executed in Study 3.

DEFINITION OF E-NUMBERS

Another question not included among the variables of the Extended SPARTA-model and which can be used for explorative reasons was an open question in which participants were asked to give their own definition of E-numbers. This can be used as an indication for an experiment as well, because the own definition given by participants provides further information with regard to the participants understanding of E-numbers.

VARIABLES OF THE EXTENDED SPARTA-MODEL

Based on the questionnaire used by Lobb *et al.* (2007) to test the SPARTA-model, the variables attitudes, subjective norm and perceived behavioural control were all measured through a 7-point Likert scale. In order to make the present survey consistent, the decision was made to measure risk perception, trust, intention to avoid E-numbers and behaviour to avoid E-numbers through a 7-point Likert scale as well. The specific scale will be elicited per variable.

Knowledge

Participants were asked to respond to a set of thirteen items whether they thought these were true or false, or that they didn't know the answer. As done by Tobler *et al.* (2012), the option 'I don't know' was included to delimit the chance of guessing by the participants. With these items, the

knowledge of participants regarding E-numbers was measured. Examples of the items are “If I eat fruit and vegetables, I don’t consume any E-numbers” and “An E-number is an additive authorized by the EU”. The full list of items can be found in Appendix E.

Attitude

To measure attitudes, sixteen items were used ($\alpha = .93$) measuring both the cognitive and the affective attitudes toward E-numbers of the participants. The items were based on the questionnaire as used for the article of Dickson-Spillmann et al. (2010) and adapted to the topic of E-numbers. An example of an item regarding the cognitive attitude is “I think the use of E-numbers did more bad than good to our food products and health”, while “The presence of E-numbers in my food scares me” is an example of an item regarding the affective attitude. For these items, participants were asked to state per item to what extent they disagreed or agreed. The responses were provided on a 7-point scale (1 = “strongly disagree”, 7 = strongly agree”). Nine items were positive items and were reversely scored, for example “In my opinion, consumers are unnecessarily worried about the effect of E-numbers on our health”.

Subjective norm

For the subjective norm, participants were asked to respond to ten items ($\alpha = .76$), such as “My friends think that I should avoid the consumption of food products containing E-numbers”. Two questions were re-numbered as they were positive items, for example “No one who is important to me has problems with me avoiding the consumption of food products containing E-numbers”. The responses were provided on a 7-point scale (1 = “strongly disagree”, 7 = strongly agree”).

Perceived behavioural control

Perceived behavioural control was measured by four items ($\alpha = .80$), such as “I am confident that I can avoid the consumption of food products containing E-numbers”. One question was re-numbered, which was “The decision to avoid the consumption of food products containing E-numbers is out of my control”. The responses were provided on a 7-point scale (1 = “strongly disagree”, 7 = strongly agree”). The items were partially based on Ajzen (2006).

Risk perception

In total, seven items were included to measure the perceived risk ($\alpha = .89$). This is measured by five selected (classes of) E-numbers (anti-oxidants, MSG, colorants, aspartame, and flavour enhancers) for which participants were asked to indicate their perceived risk on a 7-point scale (1 = “Completely no risk”, 7 = “Extensive risk”) with an added option (8) of “I don’t know this substance”. This was done to avoid participants not knowing a substance to randomly fill out a risk for it. Additionally, two questions related to E-numbers causing cancer and allergies (1 = “Strongly disagree”, 7 = “Strongly agree”).

Trust

For the measurement of trust, participants were asked to respond on seven items ($\alpha = .60$) with a 7-point scale (1 = “highly unreliable”, 7 = “highly reliable”). The selected sources for which the participants were asked to indicate the level of trust were producers, Voedingscentrum, internet, government, food package/ label, family, and friends. This selection was based on the results of Study 1.

Intention to avoid E-numbers

The participants intention to avoid the consumption of food products containing E-numbers ($\alpha = .95$) was measured by two items on a 7-point scale (1 = “Strongly disagree”, 7 = “Strongly agree”), which were “I have the intention to avoid the consumption of food products containing E-numbers as much as possible” and “I have the intention to completely avoid the consumption of food products containing E-numbers”.

Behaviour to avoid E-numbers

The behaviour regarding food products containing E-numbers ($\alpha = .65$) was measured by two items on a 7-point scale (1 = “Strongly disagree”, 7 = “Strongly agree”). These items were “In the past three months I have consumed food products without trying to avoid E-numbers” and “In the past three months I have completely avoided the consumption of food products containing E-numbers”. The scale and formulation of these items were based on Ajzen (2006).

RESULTS

DESCRIPTIVE STATISTICS AND CORRELATIONS

In this study, mainly females participated (71%), most participants fitted the age category 19 – 25 years old (26.0%) and 31-40 years old (25.7%) and had an high educational level ($M = 4.40$). Further, most participants were always responsible for doing the groceries (45.9%).

In Table 2, the means, standard deviations and Pearson correlations between the different variables can be found. Within the control variables, gender and age showed a negative correlation ($p < .05$), meaning that the females were younger compared to the male participants. Between gender and education a negative correlation ($p < .01$) was found as well, indicating that the male participants were more highly educated than female participants. Gender and responsibility for the groceries was positively correlated ($p < .05$), which indicated that females are more often responsible for the groceries. Age and education were negatively correlated ($p < .01$), meaning that the younger participants were higher educated.

For knowledge, $M = 8.05$, which indicated that the participants have quite some knowledge regarding E-numbers. The lowest mean was for subjective norm ($M = 2.88$), meaning that the participants did not feel a high social pressure to avoid E-numbers. The attitude towards E-numbers was slightly negative ($M = 4.23$), but the participants did feel some control over their decision to avoid E-numbers or not as $M = 4.37$ for perceived behavioural control. The mean scores for trust indicated that the different sources in total were slightly trusted ($M = 4.13$), while the participants did perceive some risk of E-numbers ($M = 4.65$). For the intention, the result was $M = 4.12$ while for behaviour $M = 3.26$. Thus, the participants showed a larger intention to avoid E-numbers than the actual behaviour to avoid E-numbers.

For the model variables both negative and positive correlations were found. Negative correlations were found between knowledge and attitude; trust and risk; trust and subjective norm; and trust and intention. Positive correlations were found between risk and attitude; attitude and intention; subjective norm and attitude; subjective norm and intention; perceived behavioural control and intention; risk and intention; and intention and behaviour. All of the mentioned correlations were significant ($p < .01$), except of the correlation between subjective norm and trust, which was not

significant. The latter relation was included in both the SPARTA model and the proposed Extended SPARTA-model and was thus surprising to be not significant.

The control variables gender, age and responsibility for the groceries were all negatively correlated ($p < .01$ for gender and age, $p < .05$ for responsibility) to the model variable knowledge. Education was positively correlated to knowledge ($p < .01$), indicating that a higher level of education leads to a higher level of knowledge. For the attitude the results were the other way around: gender, age and responsibility for the groceries were positively correlated ($p < .01$) to attitude, while education had a negative correlation ($p < .01$) to attitude. The subjective norm did not show any significant correlation with the control variables. The perceived behavioural control had a positive correlation with gender and responsibility for the groceries ($p < .01$ and $p < .05$ respectively), and a negative correlation with education ($p < .01$). Age was not significantly correlated to perceived behavioural control. Trust was only significantly correlated to age ($p < .01$), which was a negative correlation. Risk perception was positively correlated to all four control variables ($p < .01$). Finally, intention and behaviour both showed a positive correlation with the control variables gender, age and responsibility for the groceries ($p < .01$) and a negative correlation with education ($p < .01$).

TABLE 2 MEANS, STANDARD DEVIATIONS, AND PEARSON CORRELATIONS AMONG THE VARIABLES

	M	SD	1	2	3	4	5	6	7	8	9	10	11
1 Gender	1.71	0.46											
2 Age	3.90	1.59	-.11*										
3 Education	4.40	0.94	-1.6**	-.18**									
4 Responsible for groceries	1.75	1.65	.12*	.07	.08								
5 Knowledge	8.05	2.66	-.20**	-.19**	.29**	-.10*							
6 Attitude	4.23	1.43	.33**	.20**	-.32**	.14**	-.52**						
7 Subjective norm	2.88	0.91	.02	.10	-.08	.02	.00	.19**					
8 Perceived behavioural control	4.37	1.39	.27**	.01	-.17**	.12*	-.22**	.40**	-.00				
9 Trust	4.13	0.80	.00	-.18**	.02	-.09	.14**	-.37**	-.04	-.08			
10 Risk perception	4.65	1.57	.36**	.20**	.29**	.14**	-.41**	.80**	.18**	.39**	-.34**		
11 Intention	4.12	2.19	.34**	.19**	-.31**	.15**	-.47**	.88**	.21**	.52**	-.31**	.82**	
12 Behaviour	3.26	1.78	.29**	.14**	-.23**	.22**	-.35**	.65**	.19**	.43**	-.25**	.60**	.70**

* $p < .05$, ** $p < .01$, M = Mean, SD = Standard Deviation

The marked items refer to the hypothesized correlations between the variables

INFORMATION SOURCES USED WHEN SEARCHING E-NUMBER RELATED INFORMATION

As mentioned before, participants were asked to rank sources of information based on their perceived importance of the source when searching for information regarding E-numbers. The results of the ranking based on the mean positions are presented in Table 3.

TABLE 3 RANKING OF INFORMATION SOURCES USED WHEN SEARCHING E-NUMBER RELATED INFORMATION

Rank	Source	Mean
1	Scientists, universities	4.00
2	Internet	4.60
3	Labels on food packages	6.11
4	Institutes (e.g. Voedingscentrum, Consumentenbond)	6.24
5	Newspapers	7.53
6	Family	7.70
7	Friends	7.70
8	TV/ radio documentaries	7.97
9	Government	9.23
10	Social media	9.27
11	Doctor	9.29
12	Dietician	9.71
13	Food producers	10.60
14	TV/ radio commercials	11.14
15	Supermarkets	11.27
16	Other sources	13.63

Interestingly, labels on food packages are seen as important (rank 3), while food producers, who place the labels on the food packages, are seen as not that important (rank 13). Further, medical sources (doctor and dietician) were not reported as an important source for this topic (rank 11 and 12 respectively), while the internet is seen as very important (rank 2). The most important sources as perceived by the participants were scientists and universities, the least important were ‘other sources’. In Table 4 an overview of the other sources as described by the participants is provided.

TABLE 4 OTHER SOURCES

Naam	Frequency	%	Examples
Books	34	47.9%	<i>“Wat zit er in uw eten?”, “Weet wat je eet”, “E=Eetbaar”</i>
Scientists, Universities	11	15.5%	<i>Education, scientific journals, professional literature, WUR food site, Ralf Hartemink, research</i>
Myself	8	11.3%	<i>Own research, common sense, my own body, me</i>
Internet	7	9.9%	<i>Blog “Smakelijk”, blog “E-nummervrij”</i>
Doctor	3	4.2%	<i>Naturopathy</i>
Institutes	2	2.8%	<i>Foodwatch, Medica Natura</i>
Not applicable	2	2.8%	<i>n.a.</i>
Law	1	1.4%	<i>Legislation</i>
Social media	1	1.4%	<i>Miss Natural Facebook</i>
Mobile application (app)	1	1.4%	<i>App</i>
Bible	1	1.4%	<i>Bible</i>

The categories of sources already included in the ranking are marked

DEFINITION OF E-NUMBERS

The expressions stated by the participants as their definition of E-numbers are included in Table 5. The original Dutch version of the definitions can be found in Appendix D.

TABLE 5 DEFINITIONS OF E-NUMBERS AS STATED BY THE PARTICIPANTS

Description	Frequency	%	Examples
Addition/ agent/ additive	152	15,6%	Addition; agent; additive
Shelf life	112	11,5%	Shelf life; conservation
Taste/ smell/ colour/ texture	110	11,3%	Taste-colour-odour changers; taste and colorants
(by the EU) Authorized agent/ addition/ additive	92	9,4%	Authorized additives in our food; authorized agents; by the EU authorized agents
(sometimes) Artificial/ synthetic additives/ agents	67	6,9%	Synthetic agent; chemical additives; (often chemical) additive
Health	52	5,3%	Harmful; very stressful for my body; some definitely not healthy; unhealthy product that is no good to allergic and sensitive people
(sometimes) Natural additives/ agents	46	4,7%	Present in plants and animals; whether or not of natural origin
Unnecessary	39	4,0%	Unnecessary for the diet; unnecessary additive; redundant; unnecessary except for natural E-numbers
Quality	29	3,0%	Improvement of products
Bad	28	2,9%	Rubbish; junk; some specific E-numbers (621) are scandalous
Code/ system/ name	27	2,8%	Code for certain ingredients in foods; convenient way to check what is really in there; code for certain nutrients; coding of food additives
Safe	21	2,2%	Safe; safe if used according to the Directive
Dangerous	18	1,8%	Most are injurious; poison
Technological function	18	1,8%	Functional ingredients; technological function
Avoid	18	1,8%	Try to avoid; better to avoid
Useful	17	1,7%	Useful; useful in case of allergy for a certain substance; they are handy things
Necessary	17	1,7%	Essential for the lazy person; needed; necessary; apparently needed
Can be naturally present	16	1,6%	Also occur naturally in many products
In industrial foods	16	1,6%	Mainly in ready-to-eat meals; in processed food; in industrially produced food products
Gouget	12	1,2%	Green, orange, red E-numbers; outrageous that you need to bring a booklet to the supermarket
Food experience	12	1,2%	Provide an extra taste sensation in eating; do not fit into my dining-experiences; pure nature without pesticides and without addition of E-numbers is the best
Advantage for producers	11	1,1%	By food producers introduced with the intent to make more money; purely aimed at making revenue
Unclear/ inconvenient	8	0,8%	Crafty; unclear; confusing; the wording "authorized by the EU" is misleading
Other	6	0,6%	Agent with an effective lobby in the EU; hate people nagging about the danger of E-numbers without having an understanding of it
No answer	6	0,6%	--; xxx; not
I don't know	6	0,6%	I don't know

Insufficiently checked	4	0,4%	Too easily approved added; I think not tested in combination of different E-numbers together
Awareness	4	0,4%	Many people are not aware of the (potential) harmfulness of these E-numbers
Fine	3	0,3%	Fine additives
Ingredient	3	0,3%	An ingredient
Additive in products for personal care	2	0,2%	In care products; in make-up
New topic	1	0,1%	I am new to E-numbers, just started to discover them
Tasty	1	0,1%	Tasty

As indicated in the table, the definitions that were given the most were related to E-numbers being an addition, agent or additive (15.6%). Further, many definitions were based on the notion that E-numbers are artificial and chemical, and participants stated several times that one can only find E-numbers in industrial processed foods. This hints to a lack of knowledge regarding the presence of certain E-numbers in natural foods like fruits and vegetables. Health related definitions were provided quite frequently as well, stating that E-numbers are harmful and unhealthy (5.3%).

TESTING OF THE EXTENDED SPARTA-MODEL

In order to test the Extended SPARTA-model, a hierarchical regression analysis was performed. In this regression analysis, the dependent variable was behaviour regarding E-numbers. As not all independent variables were expected to directly influence behaviour, they were added in four steps matching the structure of the Extended SPARTA-model. First of all, the control variables gender, age and responsibility for groceries were included in step one. In the second step, risk perception and knowledge were added followed by attitude, subjective norm, perceived behavioural control and trust in the third step. Finally, in the fourth step intention was added. The regression analysis resulted in significant findings for the control variables, risk perception, knowledge, attitude, perceived behavioural control and intention as predictor to the behaviour of avoiding E-numbers. In Table 6, the results can be found.

TABLE 6 RESULTS OF REGRESSION ANALYSIS

Step and variables	Behaviour			
	1	2	3	4
1 Gender	.28***	.06	.03	.04
Age	.15**	.01	.00	.01
Responsibility for groceries	.14**	.10*	.07	.06
2 Risk perception		.52***	.16*	.05
Knowledge		-.10*	-.00	.01
3 Attitude			.41***	.19*
Subjective norm			.07	.05
Perceived behavioural control			.17***	.10*
Trust			-.02	-.02
4 Intention				.38***
ΔR^2	.13	.38	.48	.50
Adjusted R^2	.13	.38	.46	.49

*Standardized regression coefficients are report. Step 1 includes control variables, Step 2 control variables, and risk and knowledge, Step 3 includes control variables, risk and knowledge, and attitude, subjective norm, perceived behavioural control and trust. Step 4 includes control variables, risk and knowledge, attitude, subjective norm, perceived behavioural control and trust, and intention. * $p < .05$; ** $p < .01$; *** $p < .001$*

The control variables were a significant predictor of behaviour in step 1. When the model variables risk perception and knowledge were added, gender and age were not a significant predictor of behaviour anymore. The regression weight of responsibility for groceries as predictor decreased from .14 ($p < .01$) in the first step to .10 ($p < .05$) in the second step. This means that the control variables only influenced the behaviour via the model variables. This is in line with Hypothesis 1. In the second step only the model variables risk perception and knowledge were added as the expectation was that these variables would have an indirect causal relationship to behaviour via attitude and intention (Hypothesis 4). As showed in Table 6, risk perception became a less significant predictor of behaviour and knowledge was not a significant predictor to behaviour anymore, as of the moment attitude was included. Further, upon inclusion of intention, the significance of the relationship between attitude and behaviour decreased. The other model variables included in the third step alongside attitude were subjective norm, perceived behavioural control and trust. The results showed that subjective norm and trust were not significantly related to behaviour. Perceived behavioural control was a significant and positive predictor of behaviour in step three, but the significance decreased when intention was added from .17 ($p < .001$) in the third step to .10 ($p < .05$) in the fourth step. This indicated that a higher level of perceived behavioural control would lead to a higher intention to avoid E-numbers. Finally, the intention is positively related to, and is a significant predictor of, behaviour, supporting Hypothesis 13.

An additional mediation analysis was conducted by performing a bootstrap analysis (Preacher & Hayes, 2004; Shrout & Bolger, 2002). This was done in order to test whether the relationship between risk and behaviour, and knowledge and behaviour, significantly decreased when adding attitude, perceived behavioural control, subjective norm and trust. In a bootstrap analysis, 95% confidence intervals (CIs) around indirect effects are computed. CIs that do not contain zero are an indication of mediation. The test revealed that attitude mediated the positive relationship of risk with behaviour (CI range from .2402 to .4976; 5,000 bootstrap resamples; $p < .05$) and the negative relationship of knowledge and behaviour (CI range from -.2354 to -.1451; 5,000 bootstrap resamples; $p < .05$ respectively). Further, the test revealed that the relationship between risk and behaviour and knowledge and behaviour significantly decreased upon the addition of perceived behavioural control (CI range from .0499 to .1339; 5,000 bootstrap resamples; $p < .05$ and CI range from -.0569 to -.0161; 5,000 bootstrap resamples; $p < .05$ respectively). In the proposed Extended SPARTA-model, no mediation via perceived behavioural control was included for risk and knowledge.

DISCUSSION

Confirming the results of Study 1, participants of Study 2 showed basic knowledge regarding E-numbers, but a lack of knowledge regarding the presence of E-numbers in fruits and vegetables and the relation between E-numbers and health issues such as cancer and allergies. Additionally, participants with a higher level of knowledge regarding E-numbers had a lower avoidance of the consumption of food products containing E-numbers. This suggests that providing additional information regarding E-numbers could possibly decrease the avoidance of E-numbers. This is in line with the possible intervention strategies per determinant of behaviour of the RIVM, in which for knowledge “*providing good and non-contradiction information*” was considered effective (RIVM, 2004). The effect of providing additional information needs to be tested in the form of an experiment and the test results can contribute to the construction of effective information materials with the

aim of significantly improving the attitude and behaviour of consumers towards E-numbers. In the experiment, in specific information regarding the natural presence of E-numbers in certain foods and regarding E-numbers in relation to health needs to be provided as concluded from the results of Study 2.

STUDY 3 – EXPERIMENT

Following the results of the previous two studies, an experiment was designed in order to test whether providing additional information regarding E-numbers would lead to a significant increase in the level of knowledge and by that lead to a significantly more positive attitude and significant decrease in the intention to avoid E-numbers. For this purpose, half of the participants were provided with an information sheet about E-numbers and the other half, the control group, was provided with food information as well, but this information sheet included information regarding food allergies and intolerances. The information sheets can be found in Appendix F and Appendix G.

METHOD

PARTICIPANTS AND DESIGN

Study 3 had a between-subjects design. For the experiment, a sample group of in total 41 persons was used and was divided in 19 participants in the test group and 22 participants in the control group. The division of participants over the two groups was done double blind. All participants received an envelope with the respective information sheet and the questionnaire. On the envelope, no marking was placed so both the participants and the researcher were not on forehand aware of which of the two information sheets the participant would receive. To come to an equal division over the two groups, the envelopes were mixed and piled up. New participants were invited for participation until 41 envelopes were handed out and returned completed.

Selection criteria for the experiment was an age between from 31 until 40 years old. The age criterion was included as the results of Study 2 indicated that mainly persons between 31-40 years possessed a low level of knowledge regarding E-numbers. Another indication of the online survey was that lower educated persons possessed a low level of knowledge regarding the topic. In order not to scare this target group the potential participants were not asked about their educational level on forehand. Some participants indicated that after their HAVO education they continued at MBO level. For these participants HAVO/VWO level was used as their highest attended level of education. No exclusion based on gender was made, because in Study 2 the percentage of male participants was too low to make any definite conclusions regarding differences in the answers based on gender.

PROCEDURE

All participants received an envelope containing instructions, an information sheet and questions. Both versions of the information sheets had the same lay-out so people could not see that other participants might had a different version. The information sheet regarding E-numbers contained a general introduction explaining E-numbers need to be authorized by the EFSA, the way the exact number is given to a substance, followed by information regarding the natural presence of E-numbers in food products and the influence of E-numbers on allergies. The information sheet regarding food allergies and intolerances contained a general introduction on the difference between

food allergies and food intolerances and was followed by the causes and symptoms of food allergies and intolerances. The last paragraph on allergies and E-numbers was the same as used in the E-number information sheet. The questions were the same as the ones used in Study 2 for the variables knowledge, attitude and intention and the control variables. One question regarding knowledge was excluded in Study 3 as it led to too much confusion among participants. The duration of the experiment was expected to be about 10 minutes.

MEASURES

CONTROL VARIABLES

Three questions regarding control variables were included as final questions in the survey. These were related to gender (1 = "male", 2 = "female"), age (open question) and highest attended educational level (1 = "lowest education", 2 = "MAVO", 3 = "MBO", 4 = HAVO/VWO, 5 = "HBO/ (post) WO").

VARIABLES OF THE EXTENDED SPARTA-MODEL

Knowledge

Participants were asked to respond to a set of twelve items whether they thought these items were true or false, or that they didn't know the answer. For this, the set of questions used in Study 2 was used again, except for the question "Around 1900 no E-numbers were used in foods". This question was excluded because it caused too much confusion among the participants and is thus not a valid item for testing knowledge.

Attitude

To measure the attitude, the sixteen items of Study 2 were used ($\alpha = .89$) measuring both the cognitive and the affective attitude of the participants.

Intention to avoid E-numbers

Like in the online survey, the participants' intention to avoid the consumption of food products containing E-numbers ($\alpha = .90$) was measured.

RESULTS

An ANOVA that tested the effect of the information manipulation on knowledge yielded the anticipated effect, $F(1, 39) = 29.85, p < .001$. As expected, the participants who received the E-number information sheet had a higher score in the knowledge questions ($M = 9.79, SD = 1.55$) compared to the participants with the Food Intolerances information sheet ($M = 7.14, SD = 1.55$).

The ANOVA for attitude did not significantly yield the anticipated effect of providing knowledge, $F(1, 39) = 1.71, p = .20$. The participants in the E-number condition did show a slightly less negative attitude ($M = 3.41, SD = 0.90$) compared to the ones in the control condition ($M = 3.81, SD = 1.02$). The ANOVA for intention did not show a significant effect either, $F(1, 39) = 1.55, p = .221$. The intention to avoid was slightly lower for the participants in the E-number condition ($M = 2.89, SD = 1.67$) compared to the control group ($M = 3.52, SD = 1.69$).

The results for the different variables per test condition are shown in Table 7.

TABLE 7 RESULTS OF BOTH TEST CONDITIONS

	E-number information		Food intolerances information	
	M	SD	M	SD
Gender	1.74	0.45	1.77	0.43
Age	35.53	2.95	34.82	2.87
Education	4.00	0.94	4.05	1.05
Knowledge	9.79	1.55	7.14	1.55
Attitude	3.41	0.90	3.81	1.02
Intention	2.89	1.67	3.52	1.69

5. DISCUSSION

In the media, attention to E-numbers is given on a regular basis. The consumers are increasingly interested in food-related health risks (Grunert *et al.*, 2003; Hauser *et al.*, 2011; Lobb *et al.*, 2007; Wandel, 1994). However, in the scientific literature research concerning the consumers' attitude towards E-numbers in specific is relatively scarce. Hence, the current research was developed to investigate in what way mapping the avoidance of E-numbers by consumers can contribute to diminishing that avoidance. The research consisted of three studies aiming at finding the determinants for avoidance of E-numbers as well as to test the proposed Extended SPARTA-model.

The idea in the proposed Extended SPARTA-model that knowledge and risk influence the attitude, which then influences the intention to perform a certain behaviour, was confirmed. Further it was found that knowledge and risk influence the intention via the perceived behaviour control as well. Meaning, both knowledge and risk influence the extent to which participants felt in control of the decision to either perform the behaviour at stake or not, which then leads to their intention. This path was unexpected and was therefore not included in the proposed model.

In Study 3, an experiment was performed in which additional information about E-numbers was provided to part of the participants in order to further investigate the importance of knowledge as predictor for attitude and intention. Only for knowledge a significant difference was found between the group in the E-number information condition compared to the control group. This was a confirmation of the expected effect that providing additional information increases the knowledge level, but the study did not prove that the increase leads to an improvement in attitude and intention.

THEORETICAL IMPLICATIONS

The discussed models (Theory of Planned Behaviour, SPARTA model and the proposed Extended SPARTA model) all three highlighted the complexity of changing behaviour. When intervening on a variable of the proposed Extended SPARTA model, this does affect the behaviour. However, the results might not be significant as found in Study 3. In this study a significant improvement in knowledge level did not lead to a significant change in the behaviour. This indicates that a broader action plan is needed in which different variables are simultaneously addressed.

As discussed by Lobb *et al.* (2006), risk perception is a valid extension of the model of Ajzen (1991) which does not seem to influence behavioural intentions directly. Risk influences attitude and trust, which then leads to the intention. The relation between risk and intention via attitude and the relation between risk and trust were found in Study 2 as well. In Study 2, risk also influenced the intention via perceived behavioural control. This relation was not included in both the SPARTA model of Lobb *et al.* (2006) and the proposed Extended SPARTA model.

In the proposed Extended SPARTA model, knowledge was added to the original SPARTA mode of Lobb *et al.* (2006). This decision was based on the Knowledge-Deficit model, in which it is assumed that knowledge is a strong predictor of behaviour of which the relationship may not be causal (Schultz, 2002). The results of Study 2 support the Knowledge-Deficit theory as knowledge and

attitude were proven to be related via attitude and perceived behavioural control. The latter was an unexpected relation and was not included in the proposed model. The role of perceived behavioural control needs further investigation as in the current research unexpected causal relations were found of both risk and knowledge with intention via the perceived behavioural control.

Study 2 showed that subjective norm was not a significant predictor of behaviour and the expected significant relationship between subjective norm and trust did not occur. The latter was surprising, as this relation was included in both the SPARTA-model and the proposed expended SPARTA-model. However, the finding is in line with the findings of Cook *et al.* (2002) in their research towards the purchase of GM food. They found that the subjective norm was less prominent than other components as determinant for intention (Cook *et al.*, 2002). An important difference between the two researches was the direction of the relation. In the research of Cook *et al.* (2002), a possibility for the negative relation between subjective norm and behaviour was that participants who expected disapproval from family and friends regarding the purchase of GM foods would engage in behaviour that they consider to be supported by their relatives (Cook *et al.*, 2002). In the present study, this seems a very likely explanation as well. However, this time it lead to a negative relation between subjective norm and behaviour. This might be due to a difference in formulation and coding of the questions defining the two variables.

Cook *et al.* (2002) used the TPB model of Ajzen with self-identity as additional determinant of intention. Self-identity is generally interpreted as “*a label that people use to describe themselves*” (Biddle *et al.*, 1987). Various results found by Cook *et al.* (2002), such as the role of subjective norm as discussed above and the difference in intention and behaviour between age groups, seem to comply with the findings in the present research. Hence, it is suggested to further explore the determinant self-identity in the proposed SPARTA-model as well.

The result of Study 3 confirmed the idea of the RIVM (RIVM, 2004) that providing good and non-contradicting information can be an effective intervention strategy for the behavioural determinant knowledge, as the level of knowledge significantly increased when providing additional information regarding E-numbers. However, the attitude and intention did not change significantly, which is in line with the findings of Cox *et al.* (2007) that responses were not influenced when providing additional information. A possible explanation for this might be that the participants had enough basic understanding of E-numbers, even though the sample group used in Study 3 was selected on the characteristics of the participants that showed the least understanding of E-numbers in Study 2. However, this possible explanation is not valid for the control group as their score on knowledge reaches the level of probability. Hence, a more complex approach is needed when aiming to diminish the avoidance in which different determinants will be addressed simultaneously. This is in line with what Teisl *et al.* (2009) stated, “*information is only one part of the consumers acceptance puzzle*”.

PRACTICAL IMPLICATIONS

In Study 1, 47% of the participants defined E-numbers as “additions to food products” and most of them added that E-numbers contain e.g. colorants, preservatives and flavourings. This is in line with the results of Study 2 where participants were asked to provide their own description of E-numbers. In this, it was often indicated that E-numbers are additives, have influence on the conservation of foods and are important in the taste, smell, colour and texture of foods. The functions of E-numbers

in food products were also mentioned most often as advantage of E-numbers in Study 1. As Knight *et al.* (2007) suggested in relation to GM food, consumers might be more accepting GM food when full information is available and the consumer benefits are clear (Knight *et al.*, 2007). For E-numbers, this might be the case as well. Another reason for highlighting benefits was found in research of Rodríguez-Entrena and Salazar-Ordóñez (2013) regarding GM foods. Consumers were more likely to accept the food when they perceived personal, environmental or societal benefits of it, while they were less likely to accept these foods in case they perceived the food as a health or environmental risk (Rodríguez-Entrena and Salazar-Ordóñez, 2013). The main risks related with E-numbers were health risks, as more than a third of the participants stated this in Study 1. Among the health risks mentioned were the occurrence of allergies, the development of cancer and the unknown potential of developing other health issues. Altogether, ways to highlight the consumer benefits of E-numbers and reduce the perceived risk are important to consider when developing future interventions.

As found in Study 1 and 2, the presence of E-numbers in fruits and vegetables was for many participants unknown and E-numbers were often described as being artificial and chemical compounds. Meanwhile, eating natural food products is becoming more and more popular and combined with the current idea of consumers regarding E-numbers this might lead to a larger avoidance of E-numbers in the future. These findings confirm the finding of a study among British consumers that many consumers equate food additives with E-numbers, which are generally sensed as bad (Cragg Ross Dawson 2008). As Evens *et al.* (2010) found, the type of name (chemical names, E-numbers or common names of the entity) used to refer to food additives on labels influences the consumers' rating of the naturalness of foods. Considering the finding in Study 2 that participants trusted the information on food labels, this might be important to take into account when developing a plan to diminish the avoidance of E-numbers by consumers. The findings of Tenbült *et al.* (2005) suggested that the acceptance of GM foods is formed by the extent to which consumers see the products as being natural or less unnatural when the products are presented in the genetically modified form (Tenbült *et al.*, 2005). The same might be the case for the different types of E-numbers explaining the difference in perceived risk as it was found in Study 2 that the more controversial E-numbers like aspartame and MSG were seen as more risky than for example antioxidants.

Grunert *et al.* (2003) made the remark that consumers are increasingly interested in the way food is produced and develop attitudes towards certain technologies. According to these authors this is a point that food producers and food scientists will have to get used to. When seeking to diminish the avoidance of E-numbers, it is important to accept this increased interest and adapt the provided information to it. However, own experience of consumers with E-numbers and experiencing benefits of it might more easily change the consumers attitude compared to only providing information (Grunert *et al.*, 2003). At the same time, an important element to take into account in a future action plan is the trust in sources and the importance of sources for information regarding E-numbers. The importance of trust in institutions is especially important in case consumers have little information about a new technology, as indicated by Siegrist (2008). The reason is that in this case assessing the possible risks becomes more complicated for consumers. They have to rely on the institutions and thus trust in institutions becomes more important (Siegrist, 2008).

Study 2 showed that scientists/ universities, internet and food labels were considered to be the most important sources for information regarding E-numbers. Scientists/ universities and food labels were

also addressed as trusted sources. Surprisingly, related to the food labels it was found in Study 1 and 2 that while food labels are highly trusted, at the same time the food producers are distrusted by consumers as source for information about E-numbers. Even though food labels have to comply with legislation, food labels are developed by food producers. This was a new insight and is important to take into account when defining sources to use in interventions.

Besides of the trust of consumers in sources, it is also important to take the importance of sources as considered by the consumers into account. In Study 2, participants were asked to rank a list of sources in order of importance when seeking information about E-numbers. In this ranking, the same surprising division was found as for the trust in sources: labels on food packages were considered important, while food producers were considered unimportant. The medical sources were not seen as an important source. Even though most of the participants stated that persons in their personal environment would approve their consuming of food products containing E-numbers as part of the regular diet, family and friends also count for the highest scores of persons disapproving. The internet was seen as very important, but scientists and universities were seen as the most important source. Hence, when looking for the most effective source to inform consumers about E-numbers the scientists and universities as well as the internet and food labels seem to be most suitable both as important and trusted sources. An important condition for the use of internet is that the information on different websites is not contradicting. A general remark of participants in Study 1 was that more recent sources are considered more reliable due to the on-going development of science.

In their research, Cook *et al.* (2002) found that a self-identity found in people intending to purchase GM food existed among older people and males. Therefore, directing promotions towards men and older age groups was seen as an effective tactic for maintaining and encouraging positive intentions (Cook *et al.*, 2002). In line with these findings, older people and males were also the group with the lowest intention to avoid E-numbers in the present research. Hence, self-identity might be of importance as determinant for the avoidance of E-numbers as well and the same tactic might be effective. However, as also indicated by Cook *et al.* (2002) females and younger age groups were more sensitive for negative information about GM food influencing their intention. According to the results of Study 2, females are the ones most often responsible for doing the groceries and are thus the main deciders for avoiding certain foods or not. The present research showed that mainly the group of 31 – 40 year olds with a low educational level (MBO) possessed a low level of knowledge regarding E-numbers, making them more sensitive to information provided to them about E-numbers. Study 3 underlined this as the knowledge level significantly increased upon provision of additional information. This leads to the suggestion that this group is most important when seeking to decrease the avoidance of E-numbers by consumers. An additional advantage of targeting this specific group is that it mainly consists of persons with young families. It is expected that if the knowledge of this group increases, there is an increased chance that the parents will automatically pass this information on to the younger generations as well. Considering the Diffusion of Innovation Theory of Rogers (Rogers, 2010), it seems like males and older people might be considered as early adopters or pioneers while females and younger groups (in the case of E-numbers the 31 – 40 year olds in specific) are more likely to belong to the late majority or laggards with regard to new food technologies.

Even though intention to avoid food products containing E-numbers was found to be an important determinant for actual behaviour, the intention to avoid E-numbers was higher compared to the

actual behaviour. A similar result was found in a study by Rimal *et al.* (2001): even though almost half of the consumers in the US considered food additives as a serious problem, about the same amount of consumers made only little or even no change in their consumption of food additives (Rimal *et al.*, 2001). In the research of Rodríguez-Entrena and Salazar-Ordóñez (2013), the idea that behavioural intentions do not necessarily lead to an actual behaviour was mentioned as well, but no possible causes were discussed. In the present research, no investigation was performed on the possible causes of this difference either. However, to fully understand the thoughts and decision making process of the consumers it might be effective to further investigate the relation between intention and actual behaviour.

STRENGTHS AND LIMITATIONS

Even though a mix of methods (semi-structured survey in Study 1, structured survey in Study 2 and experiment in Study 3) was used to strengthen the results found, this study has limitations that need to be addressed. First limitation is with regard to the demographics of the participants used in the different studies. In Study 1, mainly higher educated persons participated which might have provided different results compared to when participants would have had different educational backgrounds. However, most of the results were confirmed in Study 2 in which besides of a large amount of higher educated persons also many lower educated persons participated. Further, the participants in Study 2 were relatively young. This might have had an effect on the result as most persons who stated that they just started to worry about E-numbers also mentioned they were young mothers. The high amount of participants in Study 2 in the age of 19 – 25 years is expected not to belong to this group of young moms, where the group that scored the lowest on knowledge does potentially have young families as they were in the age group of 31 – 40 years. The sample method used in Study 2 might have influenced the characteristics as a large number of students was invited via e-mail and Facebook. Social media and internet were both important media in the collection of participants for this study. In Study 3 these factors were avoided as a specific target group was approached face-to-face.

Furthermore, following the results of Study 1 and 2 with regard to the trusted and indicated to be important sources of information regarding E-numbers, no further investigation was done to establish which medium would be most effective for providing additional information regarding E-numbers. This was because first further investigation regarding the effectiveness of providing additional information was needed, which was tested in Study 3.

A promising result of this research is that knowledge turned out to be important throughout the different studies and can be improved by providing additional information. However, the final study did not confirm this to have a significant effect on the improvement of attitude and intention.

FUTURE DIRECTIONS

Several studies have been performed in the present research. However, based on results found and considering the limited timeframe available, the following directions for future work are advised:

- **Investigate the long-term effects of providing additional information**
Measure knowledge, attitude and intention at point 0 and measure again directly after providing additional information. After six months the variables can be measured again to check for differences occurring over a larger timeframe
- **Investigate the effect of knowledge with a broader range of age groups**
In Study 3 only the effect in the age group 31 – 40 years was tested. It is interesting to further investigate this for a broader range of age groups in order to make a more educated decision regarding the group(s) to focus upon first for a possible future intervention.
- **Research the actual behaviour instead of the intention**
Place examples of products with their chemical names, E-numbers or an indication ‘fully natural’ in a virtual supermarket and let participants make their choice. Besides of the given insight in the actual behaviour, this will also give more insight in the preference for naturalness of foods which was not focused upon in the present research.
- **Investigate the effect of providing additional information to a dogmatic group**
Regarding E-numbers, a group of people (e.g. in the naturopathy) remains dogmatic about E-numbers and influences consumers with their ideas. Researching the effect of providing additional information to this specific group might be interesting to use for the development of effective future interventions.

6. CONCLUSION

Consumers are increasingly worried about E-numbers in their food products and tend to avoid the consumption of this. However, the intention to avoid E-numbers is higher than the actual avoiding behaviour of consumers regarding E-numbers. With the aim of mapping the reasons for avoidance, the determinants for the avoidance were investigated. The current study explores in this way an area that is relatively scarcely found in existing research and extends the research findings that lead to the development of the SPARTA model by adding knowledge as a variable and testing this new proposed model. It was showed that knowledge is a valid extension of the SPARTA model which is of significant influence on the intention via attitude. Knowledge is also an area with room for improvement related to E-numbers. However, only increasing the knowledge by providing additional information did not lead to a significant change in attitude and intention. These results should be taken into account when developing campaigns to diminish the avoidance of E-numbers by consumers as more determinants need to be addressed at the same time to come to a significant change of behaviour.

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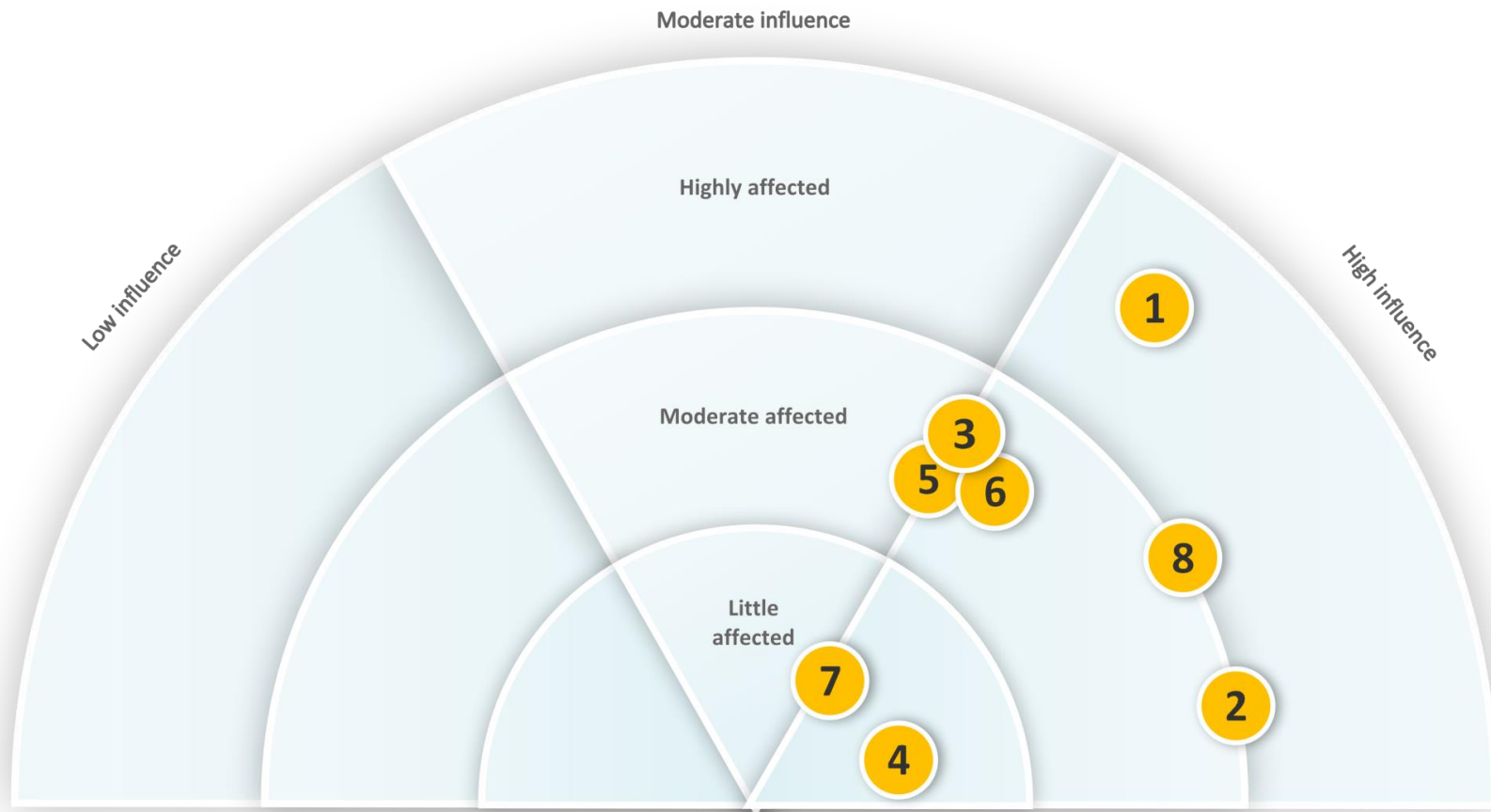
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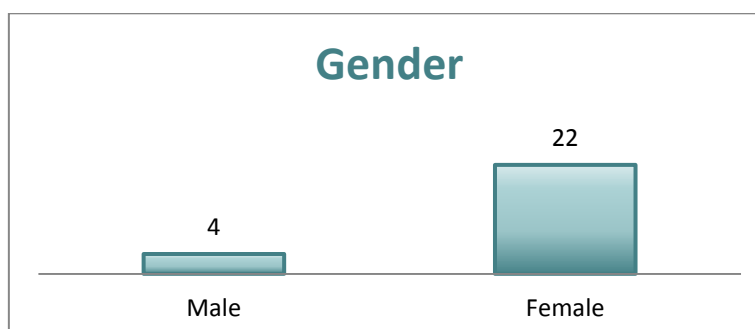
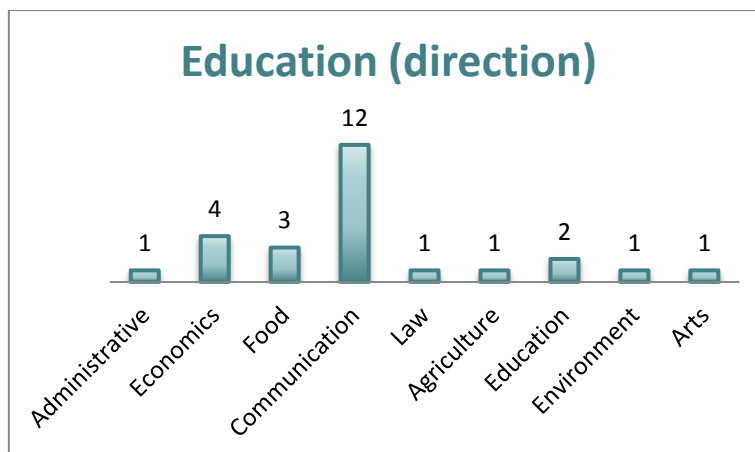
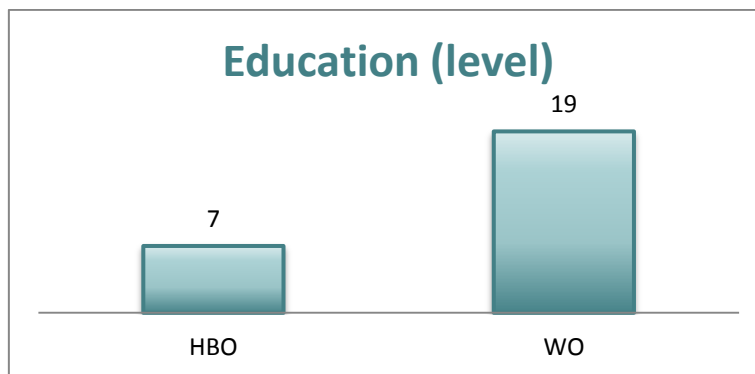
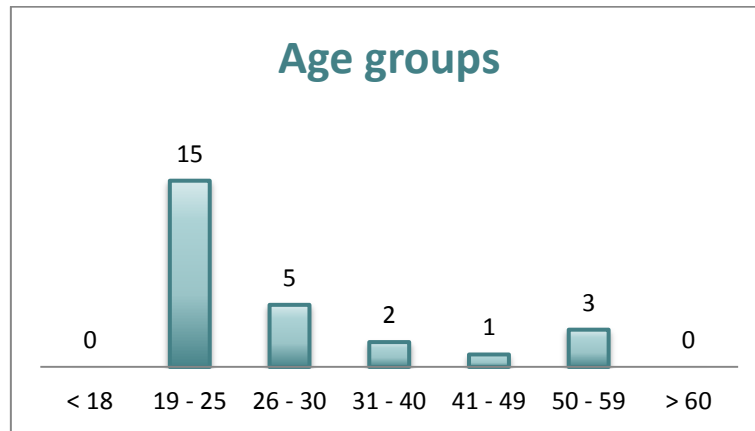
APPENDIX A

STAKEHOLDER RAINBOW



APPENDIX B

DEMOGRAPHICS ELICITATION STUDY



APPENDIX C

DUTCH ELICITATION STUDY

Hieronder vindt u een aantal open vragen met betrekking tot E-nummers. Wilt u uw antwoorden per vraag invullen in de bijbehorende tekstvakken? Alvast hartelijk dank voor uw bijdrage!

Hoe zou u E-nummers omschrijven?

Welke personen of groepen (algemeen, het noemen van namen is niet nodig) die belangrijk voor u zijn zouden uw consumptie van voedingsmiddelen met E-nummers als onderdeel van het normale voedingspatroon goedkeuren?

Welke personen of groepen (algemeen, het noemen van namen is niet nodig) die belangrijk voor u zijn zouden uw consumptie van voedingsmiddelen met E-nummers als onderdeel van het normale voedingspatroon goedkeuren?

Welke personen of groepen (algemeen, het noemen van namen is niet nodig) die belangrijk voor u zijn zouden uw consumptie van voedingsmiddelen met E-nummers als onderdeel van het normale voedingspatroon afkeuren?

Wat vindt u van de consumptie van voedingsmiddelen met E-nummers als onderdeel van het normale voedingspatroon?

Wat zijn volgens u de voordelen van het consumeren van voedingsmiddelen met E-nummers als onderdeel van het normale voedingspatroon?

Wat zijn volgens u de nadelen van de consumptie van voedingsmiddelen met E-nummers als onderdeel van het normale voedingspatroon?

Wat voor gevoel geeft het consumeren van voedingsmiddelen met E-nummers als onderdeel van het normale voedingspatroon u?

Welke factoren weerhouden u er van om voedingsmiddelen met E-nummers als onderdeel van het normale voedingspatroon te consumeren?

Wat is volgens u het voornaamste risico van de consumptie van voedingsmiddelen met E-nummers als onderdeel van het normale voedingspatroon?

Welke factoren maken het moeilijk of onmogelijk voor u om voedingsmiddelen met E-nummers als onderdeel van het normale voedingspatroon te consumeren?

Welke bronnen vindt u betrouwbaar voor het verkrijgen van informatie over E-nummers?

Welke bronnen vindt u onbetrouwbaar voor het verkrijgen van informatie over E-nummers?

Welke bronnen gebruikt u het meeste om informatie over E-nummers te verkrijgen?

Welke aspecten komen er nog meer in u op als u denkt aan het consumeren van voedingsmiddelen met E-nummers als onderdeel van het normale voedingspatroon?

APPENDIX D

DUTCH ONLINE SURVEY

Welkom bij mijn enquête over E-nummers. Deze enquête is onderdeel van mijn afstudeeronderzoek voor de master Applied Communication Science van de Wageningen Universiteit. In mijn onderzoek wil ik graag in kaart brengen hoe consumenten denken over E-nummers.

Het invullen van de enquête zal ongeveer 15 – 20 minuten duren. Al uw antwoorden zullen volledig anoniem blijven. Lees de vragen alstublieft zorgvuldig en vul de enquête volledig in.

Alvast bedankt!

In dit onderzoek krijgt u een aantal vragen met betrekking tot E-nummers in voeding. De eerste vragen bevatten stellingen over E-nummers en additieven (toevoegingen).

Beantwoord voor de stellingen hieronder of ze waar of niet waar zijn, of dat u het antwoord niet weet.

Vraag	Waar	Niet waar	Ik weet het niet
E-nummers kunnen een natuurlijke, op natuurlijk gelijkende, of synthetische hulpstof zijn	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Een E-nummer is een door de EU goedgekeurde hulpstof	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
E-nummers komen alleen voor in industriële voedingsmiddelen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Alle E-nummers zijn een voedingsadditief (toevoeging)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In biologische producten zitten geen E-nummers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Als ik groenten en fruit eet, krijg ik geen E-nummers binnen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
De hoogte van een E-nummer duidt het risico aan	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
De functie van een additief (toevoeging) bepaalt de hoogte van het E-nummer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
De E-nummer lijst wordt niet aangepast na toelating van een additief (toevoeging)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Veel mensen zijn allergisch voor E-nummers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Een appel bevat E-nummers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Rond 1900 werden er geen E-nummers in voeding gebruikt	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Additieven kunnen een rol spelen in de houdbaarheid van onze voedingsmiddelen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Hoe zou u E-nummers omschrijven?

Geef bij de volgende stellingen aan in welke mate u het ermee eens of oneens bent. Met het consumeren van voedingsmiddelen met E-nummers wordt bedoeld dat u voedingsmiddelen consumeert die E-nummers bevatten als onderdeel van uw normale dieet.

Ik denk dat het gebruik van E-nummers onze voeding en gezondheid meer slecht dan goed heeft gedaan

<i>Helemaal oneens</i>	<i>Oneens</i>	<i>Enigszins oneens</i>	<i>Niet oneens/ niet eens</i>	<i>Enigszins eens</i>	<i>Eens</i>	<i>Helemaal eens</i>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Ik maak me geen zorgen om E-nummers in onze voeding

<i>Helemaal oneens</i>	<i>Oneens</i>	<i>Enigszins oneens</i>	<i>Niet oneens/ niet eens</i>	<i>Enigszins eens</i>	<i>Eens</i>	<i>Helemaal eens</i>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Naar mijn mening maken consumenten zich onnodig zorgen over het effect van E-nummers op onze gezondheid

<i>Helemaal oneens</i>	<i>Oneens</i>	<i>Enigszins oneens</i>	<i>Niet oneens/ niet eens</i>	<i>Enigszins eens</i>	<i>Eens</i>	<i>Helemaal eens</i>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Het gebruik van minder E-nummers in voedingsmiddelen zou me blij maken

<i>Helemaal oneens</i>	<i>Oneens</i>	<i>Enigszins oneens</i>	<i>Niet oneens/ niet eens</i>	<i>Enigszins eens</i>	<i>Eens</i>	<i>Helemaal eens</i>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Ik vind dat E-nummers een belangrijke rol spelen in de kwaliteit van onze levensmiddelen

<i>Helemaal oneens</i>	<i>Oneens</i>	<i>Enigszins oneens</i>	<i>Niet oneens/ niet eens</i>	<i>Enigszins eens</i>	<i>Eens</i>	<i>Helemaal eens</i>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

De aanwezigheid van E-nummers in mijn eten maakt mij bang

<i>Helemaal oneens</i>	<i>Oneens</i>	<i>Enigszins oneens</i>	<i>Niet oneens/ niet eens</i>	<i>Enigszins eens</i>	<i>Eens</i>	<i>Helemaal eens</i>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Ik denk dat onze maatschappij met belangrijkere risico's dan het risico van E-nummers in onze voeding te maken heeft

<i>Helemaal oneens</i>	<i>Oneens</i>	<i>Enigszins oneens</i>	<i>Niet oneens/ niet eens</i>	<i>Enigszins eens</i>	<i>Eens</i>	<i>Helemaal eens</i>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Ik ben bang voor E-nummers en de risico's die daarmee worden geassocieerd

<i>Helemaal oneens</i>	<i>Oneens</i>	<i>Enigszins oneens</i>	<i>Niet oneens/ niet eens</i>	<i>Enigszins eens</i>	<i>Eens</i>	<i>Helemaal eens</i>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Ik zou graag willen leven in een wereld waarin E-nummers niet bestaan

<i>Helemaal oneens</i>	<i>Oneens</i>	<i>Enigszins oneens</i>	<i>Niet oneens/ niet eens</i>	<i>Enigszins eens</i>	<i>Eens</i>	<i>Helemaal eens</i>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Ik eet alleen bepaalde E-nummers niet

<i>Helemaal oneens</i>	<i>Oneens</i>	<i>Enigszins oneens</i>	<i>Niet oneens/ niet eens</i>	<i>Enigszins eens</i>	<i>Eens</i>	<i>Helemaal eens</i>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Ik houd mij niet bezig met de aanwezigheid van E-nummers in mijn voeding

<i>Helemaal oneens</i>	<i>Oneens</i>	<i>Enigszins oneens</i>	<i>Niet oneens/ niet eens</i>	<i>Enigszins eens</i>	<i>Eens</i>	<i>Helemaal eens</i>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

De aanwezigheid van E-nummers in mijn eten maakt mij onzeker

<i>Helemaal oneens</i>	<i>Oneens</i>	<i>Enigszins oneens</i>	<i>Niet oneens/ niet eens</i>	<i>Enigszins eens</i>	<i>Eens</i>	<i>Helemaal eens</i>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Ik voel mij onzeker als ik denk aan E-nummers in voeding

<i>Helemaal oneens</i>	<i>Oneens</i>	<i>Enigszins oneens</i>	<i>Niet oneens/ niet eens</i>	<i>Enigszins eens</i>	<i>Eens</i>	<i>Helemaal eens</i>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Ik vind mijn consumptie van voedingsmiddelen met E-nummers...

Slecht	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Goed
Onplezierig	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Plezierig
Ongezond	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Gezond

Nu volgen een aantal vragen over de mening van anderen over het consumeren van voedingsmiddelen met E-nummers.

Geef bij de volgende stellingen aan in welke mate u het ermee eens of oneens bent. Met het consumeren van voedingsmiddelen met E-nummers wordt bedoeld dat u voedingsmiddelen consumeert die E-nummers bevatten als onderdeel van uw normale dieet.

De meeste mensen die belangrijk voor mij zijn vinden dat ik de consumptie van voedingsmiddelen met E-nummers zou moeten vermijden

<i>Helemaal oneens</i>	<i>Oneens</i>	<i>Enigszins oneens</i>	<i>Niet oneens/ niet eens</i>	<i>Enigszins eens</i>	<i>Eens</i>	<i>Helemaal eens</i>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Het wordt van mij verwacht dat ik de consumptie van voedingsmiddelen met E-nummers vermijd

<i>Helemaal oneens</i>	<i>Oneens</i>	<i>Enigszins oneens</i>	<i>Niet oneens/ niet eens</i>	<i>Enigszins eens</i>	<i>Eens</i>	<i>Helemaal eens</i>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Ik weet niet wat mensen in mijn omgeving denken over het vermijden van de consumptie van voedingsmiddelen met E-nummers

<i>Helemaal oneens</i>	<i>Oneens</i>	<i>Enigszins oneens</i>	<i>Niet oneens/ niet eens</i>	<i>Enigszins eens</i>	<i>Eens</i>	<i>Helemaal eens</i>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Ik voel sociale druk om de consumptie van voedingsmiddelen met E-nummers te vermijden

<i>Helemaal oneens</i>	<i>Oneens</i>	<i>Enigszins oneens</i>	<i>Niet oneens/ niet eens</i>	<i>Enigszins eens</i>	<i>Eens</i>	<i>Helemaal eens</i>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Mensen die belangrijk voor mij zijn willen dat ik de consumptie van voedingsmiddelen met E-nummers vermijd

<i>Helemaal oneens</i>	<i>Oneens</i>	<i>Enigszins oneens</i>	<i>Niet oneens/ niet eens</i>	<i>Enigszins eens</i>	<i>Eens</i>	<i>Helemaal eens</i>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Niemand die belangrijk voor mij is heeft er problemen mee als ik de consumptie van voedingsmiddelen met E-nummers vermijd

<i>Helemaal oneens</i>	<i>Oneens</i>	<i>Enigszins oneens</i>	<i>Niet oneens/ niet eens</i>	<i>Enigszins eens</i>	<i>Eens</i>	<i>Helemaal eens</i>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Mijn vrienden vinden dat ik de consumptie van voedingsmiddelen met E-nummers zou moeten vermijden

<i>Helemaal oneens</i>	<i>Oneens</i>	<i>Enigszins oneens</i>	<i>Niet oneens/ niet eens</i>	<i>Enigszins eens</i>	<i>Eens</i>	<i>Helemaal eens</i>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

De goedkeuring van mijn vrienden voor mijn gedrag is belangrijk voor mij

<i>Helemaal oneens</i>	<i>Oneens</i>	<i>Enigszins oneens</i>	<i>Niet oneens/ niet eens</i>	<i>Enigszins eens</i>	<i>Eens</i>	<i>Helemaal eens</i>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Mijn familie vermijd de consumptie van voedingsmiddelen met E-nummers

<i>Helemaal oneens</i>	<i>Oneens</i>	<i>Enigszins oneens</i>	<i>Niet oneens/ niet eens</i>	<i>Enigszins eens</i>	<i>Eens</i>	<i>Helemaal eens</i>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Het is belangrijk voor mij om te doen wat mijn familie doet

<i>Helemaal oneens</i>	<i>Oneens</i>	<i>Enigszins oneens</i>	<i>Niet oneens/ niet eens</i>	<i>Enigszins eens</i>	<i>Eens</i>	<i>Helemaal eens</i>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Geef bij de volgende stellingen aan in welke mate u het ermee eens of oneens bent. Met het consumeren van voedingsmiddelen met E-nummers wordt bedoeld dat u voedingsmiddelen consumeert die E-nummers bevatten als onderdeel van uw normale dieet.

Ik heb vertrouwen dat ik het consumeren van voedingsmiddelen met E-nummers kan vermijden

<i>Helemaal oneens</i>	<i>Oneens</i>	<i>Enigszins oneens</i>	<i>Niet oneens/ niet eens</i>	<i>Enigszins eens</i>	<i>Eens</i>	<i>Helemaal eens</i>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

De beslissing om de consumptie van voedingsmiddelen met E-nummers te vermijden is buiten mijn controle

<i>Helemaal oneens</i>	<i>Oneens</i>	<i>Enigszins oneens</i>	<i>Niet oneens/ niet eens</i>	<i>Enigszins eens</i>	<i>Eens</i>	<i>Helemaal eens</i>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Het vermijden van de consumptie van voedingsmiddelen met E-nummers is volledig aan mijzelf

<i>Helemaal oneens</i>	<i>Oneens</i>	<i>Enigszins oneens</i>	<i>Niet oneens/ niet eens</i>	<i>Enigszins eens</i>	<i>Eens</i>	<i>Helemaal eens</i>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Het vermijden van de consumptie van voedingsmiddelen met E-nummers is makkelijk voor mij

Helemaal oneens	Oneens	Enigszins oneens	Niet oneens/ niet eens	Enigszins eens	Eens	Helemaal eens
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Nu volgen een aantal vragen over de (mogelijke) risico's van E-nummers.

Er worden nu verschillende (klassen) E-nummers genoemd. Geef hiervan aan hoe hoog u het risico van deze (klassen) E-nummers inschat.

	Helemaal geen risico	Geen risico	Enigszins geen risico	Neutraal	Enigszins risico	Risico	Helemaal risicovol	Ik ken deze stof niet
Anti-oxidanten	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
MSG/ Glutamaat	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kleurstoffen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Helemaal geen risico	Geen risico	Enigszins geen risico	Neutraal	Enigszins risico	Risico	Helemaal risicovol	Ik ken deze stof niet
Aspartaam	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Smaakversterkers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

De consumptie van E-nummers kan leiden tot kanker

Helemaal oneens	Oneens	Enigszins oneens	Niet oneens/ niet eens	Enigszins eens	Eens	Helemaal eens
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Door de consumptie van E-nummers kunnen allergieën ontstaan

Helemaal oneens	Oneens	Enigszins oneens	Niet oneens/ niet eens	Enigszins eens	Eens	Helemaal eens
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

De volgende vragen gaan over de bronnen die u gebruikt om informatie over E-nummers te krijgen en de betrouwbaarheid daarvan.

Welke bronnen zijn voor u het belangrijkste voor informatie over additieven/ E-nummers? Plaats de bronnen op volgorde van belangrijkheid door de bron aan te klikken en naar boven of beneden te verslepen. Hierbij is 1 de belangrijkste bron is en 16 de minst belangrijke bron volgens u.

Familie	Overheid
Vrienden	Instituten (zoals het Voedingscentrum, Consumentenbond)
Kranten	Supermarkten
TV/ radio commercials	Voedingsmiddelen producenten
TV/ radio documentaires	Labels op verpakkingen
Social Media	Dokter
Internet	Diëtist
Wetenschappers, universiteiten	Overige bronnen, namelijk ...

In hoeverre heeft u vertrouwen in de hierna genoemde partijen?

	Helemaal onbetrouwbaar	Onbetrouwbaar	Enigszins onbetrouwbaar	Niet onbetrouwbaar/ niet betrouwbaar	Enigszins betrouwbaar	Betrouwbaar	Helemaal betrouwbaar
Producenten	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Voedingscentrum	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Internet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Overheid	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Verpakking/ etiket	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Familie	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Vrienden	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

De volgende vragen gaan over uw consumptie van voedingsmiddelen met E-nummers. Met het consumeren van voedingsmiddelen met E-nummers wordt bedoeld dat u voedingsmiddelen consumeert die E-nummers bevatten als onderdeel van uw normale dieet.

Ik heb de intentie om de consumptie van voedingsmiddelen met E-nummers volledig te vermijden

Helemaal oneens	Oneens	Enigszins oneens	Niet oneens/ niet eens	Enigszins eens	Eens	Helemaal eens
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Ik heb de intentie om de consumptie van voedingsmiddelen met E-nummers zo veel mogelijk te vermijden

Helemaal oneens	Oneens	Enigszins oneens	Niet oneens/ niet eens	Enigszins eens	Eens	Helemaal eens
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

In de afgelopen drie maanden heb ik voedingsmiddelen geconsumeerd zonder te proberen de E-nummers te vermijden

Helemaal oneens	Oneens	Enigszins oneens	Niet oneens/ niet eens	Enigszins eens	Eens	Helemaal eens
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

In de afgelopen drie maanden heb ik de consumptie van voedingsmiddelen met E-nummers volledig vermeden

Helemaal oneens	Oneens	Enigszins oneens	Niet oneens/ niet eens	Enigszins eens	Eens	Helemaal eens
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Bent u in uw huishouden verantwoordelijk voor de boodschappen?

Nooit



Altijd

Volgt u een dieet? Zo ja, welke (bijv. glutenvrij/ vegetarisch)? Als u geen dieet volgt, vul dan in Geen

Nu volgen een aantal vragen met betrekking tot uw achtergrond.

Wat is uw geslacht?

Man

Vrouw

Wat is uw leeftijd?

18 jaar of jonger

19 – 25 jaar

26 – 30 jaar

31 – 40 jaar

41 – 49 jaar

50 – 59 jaar

60 jaar of ouder

Wat is uw hoogst genoten opleiding?

Basisonderwijs, lager beroepsonderwijs (LBO, VMBO)

Middelbaar algemeen voorbereidend onderwijs (MAVO)

Middelbaar beroepsonderwijs (MBO)

Hoger algemeen voorbereidend, Wetenschappelijk onderwijs (HAVO/VWO)

Hoger beroepsonderwijs (HBO), (post) Wetenschappelijk onderwijs (WO)

Bent/ was u werkzaam in, of studeert u voor, een voedingsmiddelen of medisch gerelateerd beroep? Kies dan hieronder de branche en vervolgens uw beroep. Als u werkzaam bent/ was in, of studeert voor, een beroep in een andere branche kies dan overig.

Voedingsmiddelen gerelateerd (bijv. Productie, retail/ supermarkt, horeca)

➤ Productie

➤ Retail

➤ Supermarkt

➤ Horeca

➤ Student

➤ Overig

Medisch gerelateerd (bijv. Arts, diëtist, verpleegkundige)

➤ Arts

➤ Diëtist

➤ Verpleegkundige

➤ Student

➤ Overig

Overig

➤ Overig

Via welke bron bent u bij deze enquête gekomen?

- Twitter*
- Facebook*
- Internet*
- Krant (graag invullen welke)*
- Tijdschrift (graag invullen welke)*
- Overig (graag invullen welke)*

Mocht u nog overige opmerkingen hebben over E-nummers, dan kunt u deze hieronder plaatsen.

APPENDIX E

DEFINITION OF E-NUMBERS (DUTCH)

Description	Frequency	%	Examples
Toevoeging/ hulpstof/ additief	152	15,6%	toevoeging; hulpstof; additief
Houdbaarheid	112	11,5%	houdbaarheid; conservering
Smaak/ geur/ kleur/ textuur	110	11,3%	smaak-kleur-geurveranderaars; smaak en kleurstoffen
(door de EU) Goedgekeurde hulpstof/ toevoeging/ additief	92	9,4%	goedgekeurde toevoeging in ons eten; goedgekeurde hulpstoffen; door EU goedgekeurde hulpstoffen
(soms) Kunstmatige/ syntetische toevoegingen/ stoffen	67	6,9%	synthetische hulpstof; chemische additieven; (vaak chemische) toevoeging
Gezondheid	52	5,3%	schadelijk; zeer belastend voor mijn lichaam; sommige bepaald niet gezond; ongezond product dat niet goed is voor allergische en gevoelige mensen;
(soms) Natuurlijke toevoegingen/ stoffen	46	4,7%	komt voor in planten en dieren; van al dan niet natuurlijke oorsprong
Onnodig	39	4,0%	overbodig voor het dieet; onnodige toevoeging; overbodig; onnodig op natuurlijke e-nummers na
Kwaliteit	29	3,0%	verbeteren van producten
Slecht	28	2,9%	rommel; troep; een aantal specifieke E-nummers (621) zijn schandalig
Code/ systeem/ naam	27	2,8%	code voor bepaalde stoffen die in voedingsmiddelen zitten; handige manier om te kijken wat er nu werkelijk in zit; code voor bepaalde voedingsstoffen; codering van voedingsmiddelenadditieven
Veilig	21	2,2%	veilig; veilig mits toegepast volgens de richtlijn
Gevaarlijk	18	1,8%	de meeste zijn schadelijk; gif
Technologische functie	18	1,8%	functionele ingrediënten; technologische functie
Vermijden	18	1,8%	proberen te vermijden; beter om te vermijden
Nuttig	17	1,7%	nuttig; handig bij allergie voor bepaalde stof; het zijn handige dingen
Nodig	17	1,7%	essentieel voor de gemakzuchtige mens; nodig; noodzakelijk; blijkaar nodig
Kunnen in natuurlijke producten voorkomen	16	1,6%	komen ook van nature in veel producten voor
In industriële voeding	16	1,6%	voornamelijk in kant en klaar maaltijden; in bewerkt eten; in industrieel geproduceerde voedingsmiddelen
Gouget	12	1,2%	groene, oranje, rode e-nummers; schandalig dat je met boekje naar de supermarkt moet
Eetbelevnis	12	1,2%	zorgen voor een extra sensatie in eten; passen niet in mijn eet-belevnissen; Puur natuur zonder

			bestrijdingsmiddelen en geen toevoegingen van E-nummers is het beste
Voordeel voor fabrikant/ producent	11	1,1%	door voedingsfabrikanten geïntroduceerd met het oogmerk meer geld te verdienen; puur gericht op omzet maken
Onduidelijk/ lastig	8	0,8%	listig; onduidelijk; verwarrend; De bewoording 'goedgekeurd door deEU' is misleidend.
Overig	6	0,6%	hulpsof met effectieve lobby bij de EU; hekel aan mensen die over het gevaar van E-nummers zeuren zonder er verstand van te hebben;
Geen antwoord	6	0,6%	--; xxx; niet
Ik weet het niet	6	0,6%	ik heb geen idee
Niet voldoende gecontroleerd	4	0,4%	te makkelijk goedgekeurd toegevoegd; volgens mij niet getest in combinatie van verschillende e-nummers bij elkaar
Bewustzijn	4	0,4%	veel mensen zijn niet op de hoogte van de (mogelijke) schadelijkheid van deze e-nummer.
Prima	3	0,3%	prima hulpstoffen
Ingrediënt	3	0,3%	een ingrediënt;
Toevoeging aan verzorgingsproducten	2	0,2%	in verzorgingsproducten; in make-up
Nieuw onderwerp	1	0,1%	sta in kinderschoenen mbt e-nummers, begin het nu pas te ontdekken
Lekker	1	0,1%	lekker

INFORMATIE

E-nummers in voeding



E-nummers zijn ook in natuurlijke voedingsmiddelen te vinden

Introductie

Aan voeding worden soms additieven toegevoegd, bijvoorbeeld om het langer houdbaar te maken of om een mooie kleur aan het product te geven.

De additieven moeten aan strenge eisen voldoen. Ze worden uitgebreid getest en krijgen pas een E-nummer als ze veilig zijn bevonden door de Europese Voedselveiligheid Autoriteit (EFSA).

De hoogte van het E-nummer hangt af van de functie. Kleurstoffen krijgen bijvoorbeeld een nummer van E100 tot E200, terwijl de nummers tussen E400 en E500 bij verdikkingsmiddelen horen.

Natuurlijke producten

E-nummers komen ook van nature al voor in voeding. Neem bijvoorbeeld de appel, hierin zijn minimaal 11 E-nummers te vinden. Of de tomaat, waarin ook veel E-nummers te vinden zijn. Geen van deze stoffen is toegevoegd aan de appel of tomaat, maar zitten hier van nature al in. Een ander voorbeeld is Vitamine C, hieraan is het nummer E300 toegekend. En tenslotte heeft ook zuurstof, wat we ademen, een E-nummer gekregen (E948).

De E-nummers die in bewerkte producten zijn toegevoegd kunnen een natuurlijke, natuurlijk gelijkende of een synthetische stof zijn. Natuurlijk gelijkende en synthetische stoffen worden beide in een laboratorium gemaakt. Het verschil is dat een natuurlijk gelijkende stof ook in de natuur voorkomt en precies dezelfde eigenschappen als de natuurlijke variant bevat.

Allergieën en E-nummers

Het consumeren van E-nummers leidt niet tot het ontstaan van allergieën en voedselintoleranties. Sommige mensen kunnen wel allergisch reageren op natuurlijke E-nummers doordat de E-nummers uit de plant worden gehaald en er nog eiwitten uit de plant als verontreiniging in het E-nummer kunnen zitten. Het E-nummer zelf kan geen allergie veroorzaken.



Een appel bevat 11 E-nummers

INFORMATIE

Voedselovergevoeligheid



Verzamelnaam voor
voedselallergie en
voedselintolerantie

Introductie

Voedselovergevoeligheid is de verzamelnaam voor voedselallergie en voedselintolerantie. Dit kan een reactie zijn op stoffen die van nature voorkomen in voedingsmiddelen of die er aan toegevoegd zijn.

Bij een voedselallergie worden er specifieke antistoffen aangemaakt door het afweersysteem tegen eiwitten uit voeding.

Bij een voedselintolerantie geeft het lichaam ook een reactie op bepaalde voedingsmiddelen, maar hierin speelt het afweersysteem geen (belangrijke) rol.

Oorzaken en symptomen

Een groot deel van de voedselallergieën wordt veroorzaakt door melk, eieren, pinda's, noten, granen, soja, sesamzaad, vis en schaal- en schelpdieren. Een allergie voor fruit en groenten komt ook regelmatig voor. In Nederland hebben ongeveer 800.000 mensen last van voedselallergieën.

Intoleranties zijn niet levensbedreigend, maar een voedselallergie kan wel levensbedreigend zijn. De symptomen kunnen heel verschillend zijn. Een voedselallergie kan bijvoorbeeld leiden tot ademhalingsproblemen of uitslag over het hele lichaam. Een voedselintolerantie leidt bijvoorbeeld tot darmklachten.

Allergieën en E-nummers

Het consumeren van E-nummers leidt niet tot het ontstaan van allergieën en voedselintoleranties. Sommige mensen kunnen wel allergisch reageren op natuurlijke E-nummers doordat de E-nummers uit de plant worden gehaald en er nog eiwitten uit de plant als verontreiniging in het E-nummer kunnen zitten. Het E-nummer zelf kan geen allergie veroorzaken.



800.000 mensen met
voedselallergie
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