Attitude towards sustainable meat production technology- synthetic In-Vitro-Meat

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Samenvatting

De wereldpopulatie groeit snel waarbij ook onze vraag naar vlees blijft groeien. Door deze blijvend groeiende vraag naar vlees en de negatieve invloed hiervan op het milieu, is het belangrijk om alternatieven voor traditioneel vlees te onderzoeken. Een alternatief voor het gebruik van traditioneel vlees zou het gebruik van In-Vitro-Meat (IVM) kunnen zijn, dit is vlees dat geproduceerd wordt door tissue engineering technologieën in een laboratorium. Om traditioneel vlees te vervangen met IVM is het wenselijk dat men een positieve houding heeft tegenover dit alternatief. Er is een online experiment gedaan om te onderzoeken of beïnvloeding invloed kan uitoefenen op de houding die men heeft ten opzichte van IVM. Het experiment is gebaseerd op de theorie van gepland gedrag. Deze theorie stelt dat het gedrag van iemand wordt bepaald door hun intentie om het gedrag uit te voeren. De intentie om IVM te consumeren kan worden bepaald door de houding die men heeft, de subjectieve norm die men ervaart en de waargenomen gedragscontrole. Het doel van dit onderzoek is om te onderzoeken of aanvullende informatie over de zintuiglijke kenmerken van IVM en de subjectieve norm die men waarneemt, de houding van mensen ten opzichte van IVM en hun intentie om IVM te consumeren kan beïnvloeden. Er is gebruik gemaakt van algemene informatie over IVM en positieve aanvullende informatie over de zintuiglijke kenmerken van IVM om te onderzoeken of de meningen en houding van de respondenten te beïnvloeden zijn. Als representatie en beïnvloeding van de subjectieve norm is ervoor gekozen om gebruik te maken van Facebook. Het online experiment is gebaseerd op een between-group design. De respondenten zijn willekeurig verdeeld met behulp van een 2 bij 2 ontwerp. De afhankelijke variabelen houding, waargenomen potentieel, meningen over zintuiglijke kenmerken en de gedragsintentie van de respondenten ten opzichte van IVM worden voor en na de beïnvloeding van de Facebook berichten gemeten. Er is geen significant effect gevonden tussen het enkel verstrekken van neutrale informatie over IVM, het aanbieden van aanvullende positieve informatie over de zintuiglijke kenmerken van IVM en de beïnvloeding van de Facebook-berichten op de afhankelijke variabelen. Een beperking van het onderzoek kan het gebrek aan exposure zijn. Het is daarom wenselijk om, bij toekomstige onderzoeken, exposure aan IVM aan te bieden om de houding van mensen ten opzichte van In-Vitro-Meat mogelijk te beïnvloeden.

Abstract

The world population is growing rapidly and the demand for meat continues to grow. Because of this lasting growing demand for meat and its major negative impact on the environment, it is of interest to explore alternatives for the consumption and production of meat. An alternative for traditional meat could be In-Vitro-Meat (IVM), which is meat produced by tissue engineering technologies in a laboratory. In order to replace traditional meat with IVM, it is desirable that people have a positive attitude towards this alternative. An online experiment was conducted to examine whether treatment can have an influence on the attitude one has towards IVM. The experiment is based on the Theory of Planned Behavior. This theory states that someone's behavior is determined by their intention to conduct the behavior. The intention to consume IVM can be determined by the attitude one has, the subjective norm they experience and their perceived behavioral control. The objective of this research is to examine whether additional positive information about the sensory characteristics of IVM and the subjective norm that people perceive, affect their attitude towards IVM and their intentions for IVM consumption. The participants are given general information about IVM and additional positive information about the sensory characteristics of IVM to examine if their opinions and attitude could be influenced. The decision has been made to use Facebook posts about IVM as a representation and treatment of the subjective norm. This online experiment is based on a between-group design. The participants are randomly divided using a 2 by 2 design. The attitude, perceived potential, beliefs about sensory characteristics and the behavioral intention of the participants towards In-Vitro-Meat are measured before and after the manipulation of the Facebook posts. No significant effect has been found between merely providing neutral information about IVM, offering additional positive information about the sensory characteristics of IVM and influencing the Facebook messages on the dependent variables. A limitation of the research may be the lack of exposure. It is therefore advisable to offer exposure to IVM in future studies in order to possibly influence the attitude of people towards In-Vitro-Meat.

Introduction

Growing world population

With the growing world population and its rapidly increasing food and meat consumption, it is of interest to explore alternatives for the consumption and production of meat. With the rate the global population is growing, the world will not be able to keep up with the demands for meat. The growth of the world population over the last 60 years, with a world population of 2.5 billion in 1950, 3.7 billion in 1970 and 6.9 billion in 2010, shows us the rate of the world population growth. The United Nations population projections indicate that the global population could reach 9.15 billion in 2050 (Alexandratos & Bruinsma, 2012). With the growing world population there is also a growth in the global food consumption. For example China's meat consumption has doubled over the past decade (McMichael, Powles, Butler, & Uauy, 2007). The meat consumption of the USA and the UK is double the global average (Macdiarmid, Douglas, & Campbell, 2015). McMichael et al. (2007) state that the current average global meat consumption is around 100 grams per day per person.

Consequences of meat consumption

An essential question to asked is: what are the consequences of meat consumption? A consequence of our meat consumption and the traditional meat production is its influence on the climate change that is occuring in the world. The production of traditional meat consumes a great deal of resources such as water, corn and soybeans.

For example, McMichael et al. (2007) state that China has increasingly been relying on Brazilian soybean to feed its expanding populations of chickens and pigs. India, South Africa and some other emerging economies are starting to import soybeans to feed their animals. And the European Union's annual imports of soybeans increased from 3 million tonnes to 11 million tonnes. This increase will continue to exist when the population and its demands will keep growing (McMichael et al., 2007).

Another consequence of the global meat production are the so called greenhouse gas emissions. These greenhouse gases are one of the significant causes of climate change. The livestock production is responsible for generating 14% of all human-caused greenhouse emissions. And the global meat production uses almost one-third of the global land area (Swain, Blomqvist, McNamara, & Ripple, 2017).

Alternatives

In what way can the consequences of a growing meat demand be prevented or limited? There are alternatives available for our meat consumption to prevent or limit these climate changes and to sustain the demand.

The first alternative could be the use of soybeans or tofu as a meat substitute. Instead of using soybeans as food for the livestock there is the possibility to consume those resources ourselves. Even though soybeans have made an introduction in more countries, the percentage of domestic use of soybean supplies intended for direct consumption still remains below 10 % at the global level according to FAO (2004).

Another alternative could be entomophagy, the consumption of insects by humans. Entomophagy has always been part of human diets in some countries. However, the influence of Western diets has changed the view upon insect-based diets. The result is that entomophagy is look down upon. Another obstacle for a global consumption of insects is obtaining a constant supply of insects (Halloran & Vantomme, 2013).

The alternative to increase the tax on meat, in order to reduce the meat consumption, has showed not to be effective according to FAO (2017).

In-Vitro-Meat

Even though the alternatives given above, there will always be a high demand for meat. Prikhodko, Davleyev, and Investment Centre Division (2014) state in their research on the Russian meat sector, that the global food demand has been experiencing massive changes, which include a shift from staple foods to animal proteins. Prikhodko et al. (2014) state that this trend in the global food demand will continue and the demand for meat and dairy products will increase. An alternative to keep up with this growing demand could be In-Vitro-Meat (IVM). IVM doesn't require livestock or agricultural land to produce. IVM is a meat manufacturing process without the need of killing animals, it's manufactured through tissue engineering technologies in a laboratory. The production of IVM involves culturing muscle tissue in a bioreactor, which can be collected from animal biopsy or animal embryos (Bhat, Kumar, & Bhat, 2017). Those tissue samples are then put into a culture media, where it will start to grow on its own. When sufficiently grown, the meat will be processed and can be used to make burgers or nuggets (Bhat et al., 2017).

The attitude of people towards traditional meat substitutes is mainly negative (Vanhonacker, Van Loo, Gellynck, & Verbeke, 2012). In order for IVM to be socially accepted and consumed, this negative attitude needs to change. The objective of this study is to examine if the attitude of people towards IVM can be influenced.

This will lead to the following research question:
How does the subjective norm influence the attitude, perceived potential, beliefs on sensory characteristics and behavioral intention of people towards In-Vitro-Meat?

Theoretical Framework

The Theory of Planned Behavior of Ajzen (1991) will be the foundation of this study and it suggests that someone's behavior is determined by their intention to perform the behavior. The intention to replace traditional meat for IVM can be determined by three factors:

1. Their attitude toward the consumption of In-Vitro-Meat
2. Their subjective norm
3. Their perceived behavioral control

These three factors are not the only factors that influence the behavioral intention. The sensory characteristics of meat substitutes, consisting of the taste and texture, also play a decisive part in the decision to change their behavior. Alternatives for traditional meat are often perceived to be of a lower quality and less sensory properties than traditional meat. This negative perception of the sensory characteristics of meat substitutes is considered a barrier for consumers and prevents them from changing their meat consumption to meat substitutes (Vanhonacker, Van Loo, Gellynck, & Verbeke, 2012).

Figure 1 illustrates a schematic representation of the three factors of the Theory of Planned Behavior and the factor Beliefs on sensory characteristics. The arrows indicate the influence these factors might have on each other.

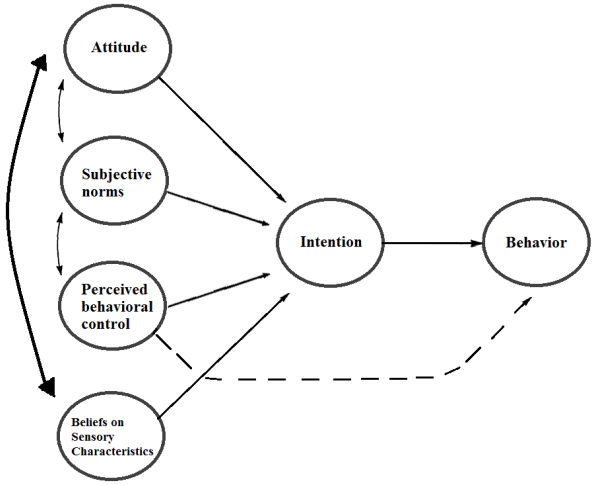

Figure 1. Schematic representation of Theory of Planned Behavior and Beliefs on sensory characteristics

Current study

In order to answer the research question and to be able to determine a change in attitude, it is necessary to examine whether the attitude can be influenced, this has been done by conducting an online experiment. The Theory of Planned Behavior states that attitude can be influenced through the subjective norm (Ajzen, 1991). There has been some research conducted about the influence of social media on the attitude of people. Yoo, Yang and Cho (2016) state that people with a great exposure to social media messages, assume that these messages will reach a wider audience, which is causing them to develop a subjective sense that more of their peers are influenced by those messages. The perceived social media influence of peers can form, develop, or change individuals' attitudes and behavioral intentions (Yoo et al., 2016). To examine the influence of the subjective norm on attitude, the decision has been made to use Facebook as a representation of the subjective norm. Cheung, Chiu, and Lee (2011) state that Facebook is one of the popular social media platforms used today, which is often used as an information source. It is therefore probable that Facebook has influence on forming someone's opinion about various topics.

Variables

The two independent variables that are used in this research are an article and a Facebook post with a response about the article. The article provides all the participants with a neutral explanation about IVM and how it is produced. The Article has two experimental conditions: the article with additional positive information about the sensory characteristics of IVM, or the article without this additional positive information. The Facebook post shows a response to the article and has comments that are mainly positive or mainly negative towards IVM.

The dependent variables are attitude, perceived potential, behavioral intention and beliefs on sensory characteristics. Where attitude is the general stance of the participants towards IVM and perceived potential is a measure to determine to which extend the participants feel that IVM has real-world potential. The behavioral intention determine the willingness of the participants to use IVM in the future and the beliefs on the sensory characteristics shows the beliefs the participants have on the taste and texture of IVM.

Hypotheses

This study will determine if different information given in the independent variables has an effect on any of the dependent variables by answering the following research question:

How does the subjective norm influence the attitude, perceived potential, beliefs on sensory characteristics and behavioral intention of people towards In-Vitro-Meat?

To be able to answer this question there are three hypotheses formulated:

1. *Positive responses on Facebook post will lead to a more positive attitude, perceived potential, beliefs on sensory characteristics and a higher behavioral intent towards In-Vitro-Meat.*
2. *Additional positive information about the sensory characteristics of In-Vitro-Meat will lead to a more positive attitude, perceived potential, beliefs on sensory characteristics and a higher behavioral intent towards In-Vitro-Meat.*
3. *The combination of the additional positive information about the sensory characteristics of In-Vitro-Meat and the positive responses on the Facebook post will lead to a more positive attitude, perceived potential, beliefs on sensory characteristics and a higher behavioral intent towards In-Vitro-Meat rather than none or one of these conditions occur.*

Method

Design

To conduct this research the decision has been made to conduct an online experiment. The experimental model is constructed according to a between-group-design. The participants are randomly divided using a 2 by 2 design:

2 (Additional positive information: [*yes, no*]) * 2 (Facebook post: [*positive, negative*])

Table 1. Participants per condition combination

		Facebook responses	
		Positive	Negative
Article Type	Neutral	N=27	N=25
	Neutral + Additional positive sensory Information	N=25	N=27

All participants are given neutral information about IVM, presented in the form of an article. The article (Appendix A) is written for this research and is based on the research of Bhat et al. (2017). The information given in the article is a neutral explanation of how IVM is produced and why this could be an alternative for the traditional meat production. The article also contains a picture of an actual IVM in a petri dish. Two groups are given additional positive information in the article, this information is a positive explanation towards the sensory characteristics of IVM. It describes the taste, texture and structure of IVM in a positive manner. All groups are randomly assigned a Facebook post, where the responses could be mainly positive (Appendix B) or mainly negative (Appendix C).

Manipulation

The participants received 2 possible manipulations. The participants are manipulated by the use of either mainly positive or negative Facebook responses on the article about IVM. The participants are once more manipulated by either receiving additional positive information about sensory characteristics in the article or not receiving this additional positive information about sensory characteristics. For the purpose of this experiment the participants are not made aware of the manipulation during the experiment. They will be informed about the manipulations and the objective of the experiment after finishing the experiment.

Manipulation check

A manipulation check has been conducted to examine whether the manipulation is received correctly by the participants. To be able to conduct a manipulation check, the control question: *Were the facebook reactions about In-Vitro-Meat positive or negative?* has been added at the end of the experiment. The question could be answered with an Likert-scale from 1 (extremely positive) to 5 (extremely negative).

An correlation analysis is conducted to examine the correlation between the control-question and the received manipulation. The analysis shows that there is a strong correlation $r = .60$ between the answers of the control question and the received manipulation, which is significant at $p < .001$. The analysis of the control question shows that none of the participants interpreted the positive Facebook post as negative. Nor interpreted the participants the negative Facebook post as positive.

Procedure

Before conducting the experiment, a permission request has been made for this online experiment. The permission is granted by the Ethical Commision of the University of Twente. The questionnaire used for this experiment has been listed on Sona-Systems. When the participants start with the questionnaire they are asked to give an informed consent for participating in this experiment. After they agree and give their consent they are asked socio-demographic questions about their age, gender and their average meat consumption. After answering the questions they are asked to read the article thoroughly. After reading the article they are given statements, where they are asked to report how much they agree or disagree with these statements. The statements are about their attitude, perceived potential, behavioral intentions and their beliefs on the characteristics of IVM. After responding to these statements

they are shown a Facebook post about the article on IVM, the responses on the Facebook post are mainly positive or negative towards IVM. After reading this Facebook post they are asked to report how much they agree or disagree with the same statements as given earlier. The final part of the questionnaire contains control questions about the reliability of the manipulation used in the experiment. Lastly they are asked if they know any other sustainable alternatives for meat consumption and they have the possibility to comment on the experiment.

Participants

The ideal number of participants would be a minimum of 100, consisting of 50 male participants and 50 female participants. Eventually 106 people participated in this research, with two fallouts as a result of incomplete questionnaires. From the 104 participants with complete filled in questionnaires, 13 were male and 91 were female. All of the participants were students at the University of Twente and were collected through Sona-systems, which is a system to gather participants for psychological research. Students got credit (0.25) for participating in this experiment. The average age of all the participants was 20 years old, with a minimum of 18 and a maximum of 30. There was only one condition for participating in this experiment, the participants needed to have a proper understanding of the English language due to the fact that the experiment is in English.

Socio-demographic variables

To examine if there are differences between the participants groups on the socio-demographic variables, a randomization check has been conducted. Table 2 shows the results of the Chi-square test and shows that there is no significant difference between the participants groups on gender and their meat consumption. A t-test has been conducted for the variable age, there is no significant difference in age between the participants groups.

Table 2: Chi-square and t-tests on socio-demographic variables

		Article type		**Facebook post type**	
Variables	*Test*	*Value*	*p-value*	*value*	*p-value*
Gender	X_2	2.20	.14	.79	.37
Age	t-test	0.00	1.00	1.07	.29
Meat consumption	X_2	2.54	.64	.54	.97

Variables and measurement tools

The only measurement tool used for this research is Qualtrics. There was a Qualtrics questionnaire with general and socio-demographic questions and statements about the 4 dependent variables, attitude, perceived potential, behavioral intentions and beliefs on the sensory characteristics of IVM. A Likert-scale, from 1 (strongly disagree) to 5 (strongly agree), has been used for the statements. The questions and statements used in this experiment are:

Socio-demographic

The socio-demographic questions that the participants had to answer, were the following 4 questions;

1. What is your age?
2. What is your gender?
3. Do you eat meat?
4. How many times a week do you eat meat?

Attitude

The following statements were given to the participants to measure their attitude about IVM. They had to report on how much they agree or disagree with these 6 statements;

1. I find the development of In-Vitro-Meat important
2. In-Vitro-Meat is scary (recoded)
3. I think In-Vitro-Meat is ethically acceptable
4. I think In-Vitro-Meat has more pros than cons
5. I think eating meat from animals is ethically acceptable
6. In-Vitro-Meat is not natural (recoded)

Perceived potential

The following statements were given to the participants to measure the *Perceived potential* of the participants about IVM. They had to report on how much they agree or disagree with these 4 statements;

1. I like the idea of In-Vitro-Meat
2. I don't think In-Vitro-Meat is a feasible product (recoded)
3. I think there is a lot of disadvantages in producing In-Vitro-Meat (recoded)
4. I think there should be more research towards In-Vitro-Meat

Behavioral intentions

The following statements were given to the participants to measure the behavioral intentions of the participants about consuming IVM in the future. They had to report on how much they agree or disagree with these 3 statements;

1. I will eat In-Vitro-Meat if it is available
2. I would like to try In-Vitro-Meat
3. I rather eat meat from an animal than In-Vitro-Meat (recoded)

Beliefs on sensory characteristics

The following statements were given to the participants to measure their beliefs on the sensory characteristics of IVM. They had to report on how much they agree or disagree with these 3 statements;

1. I think In-Vitro-Meat will taste like regular meat
2. I think the texture of In-Vitro-Meat will be good
3. I think the taste of In-Vitro-Meat will be bad (recoded)

Reliability

To examine the reliability of the statements for the dependent variables a Cronbach's alpha en a Guttman's lambda 2 (λ2) has been conducted on the provided statements. Because of the low number of statements an Cronbach's alpha $\alpha > .60$ is considered to be reliable. The Guttman's lambda 2 (λ2) is considered moderate reliable when $\lambda 2 \geq 0.70$. The dependent variable attitude has an $\alpha = 0.6$, indicating a high level of internal consistency. The λ2 of attitude indicates a moderate reliability of $\lambda 2 = .73$ for the total sample.

The dependent variable perceived potential has an $\alpha = 0.69$, indicating a high level of internal consistency. The λ2 of perceived potential indicates a moderate reliability of $\lambda 2 = .70$ for the total sample.

The dependent variable behavioral intentions has an $\alpha = 0.67$, indicating a high level of internal consistency. The λ2 of behavioral intentions indicates a moderate reliability of $\lambda 2 = .74$ for the total sample.

The dependent variable beliefs on sensory characteristics has an $\alpha = 0.86$, indicating a high level of internal consistency. The λ2 of behavioral intentions indicates a moderate reliability of $\lambda 2 = .85$ for the total sample.

Analysis

To conduct the online experiment the survey software of the program Qualtrics has been used. The dataset from Qualtrics has been imported to IBM SPSS Statistics 21 for further analysis. The dataset has been recoded and grouped to make the answers on the questionnaire uniform and suitable for analysis. To check whether the manipulation is received correctly by the participants a manipulation check has been conducted. To examine the reliability of the statements for the dependent variables a Cronbach's alpha en a Guttman's lambda 2 (λ2) has been conducted on the provided statements. The correlations, means and standard deviations are calculated for the variables attitude, beliefs on sensory characteristics, perceived potential and behavioral intention. To test if the homogeneity of variance occurs ($p > 0.05$) in the different conditions a Levene's test is done on all conditions. In order to answer the hypotheses a two-way ANOVA and an one-way ANCOVA are conducted. In order to test how the participants score on the dependent variables per condition, an analysis of the means has been conducted per condition.

Results

Correlations of dependent variables, standard deviations and means

To examine how the participants scored on the dependent variables, an analysis of the means has been conducted. The results of the analysis of the means (table 3) indicate that the participants score on average above the midpoint (3) of the 5 point Likert-scale on all of the dependent variables. With a mean that is higher than the midpoint (3) the participants are more positive towards the dependent variables. There is a strong positive correlation between all the dependent variables, these correlations are significant ($p < .001$).

In order to examine homogeneity of variances a Levene's test was conducted, it shows that there is homogeneity of variances on each of the 4 variables ($p > 0.05$).

Table 3: Correlation of the dependent variables (N=104)

			Correlations			
Variables	*Mean*	*SD*	*Attitude*	*Perceived potential*	*Sensory*	*Intention*
Attitude	3.20	0.68	1.00			
Perceived potential	3.62	0.73	.75**	1.00		
Sensory	3.21	0.88	.55**	.60**	1.00	
Behavioral Intention	3.15	0.98	.65**	.64**	.52**	1.00

** *Correlation is significant at the 0.01 level (2-tailed)*

Manipulation effect

An one-way ANCOVA (table 4) was conducted to examine whether there is a significant difference between the pre- and post-manipulation in dependent variable scores.

Table 4: One-way ANCOVA

	Facebook		
Variables	*F*	*p-Value*	η_2
Attitude	0.15	.70	.00
Perceived potential	0.99	.32	.01
Sensory	0.52	.47	.00
Behavioral Intention	0.02	.89	.00

After adjustment for pre-manipulation dependent variable scores, the one-way ANCOVA showed no statistically significant difference in post-manipulation dependent variable scores between the manipulations.

Means analysis

To examine how the participants scored on the dependent variables per manipulation set, an analysis of the means of the dependent variables for each experimental condition has been conducted.

Table 5: Means and the standard deviations of the experimental conditions

	Neutral Article						**Neutral Article + Positive sensory information**					
	Positive FB posts (N=27)		*Negative FB posts* (N=25)		*Total (N=52)*		*Positive FB posts (N=25)*		*Negative FB posts (N=27)*		*Total (N=52)*	
Variables	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Attitude	3.24	0.66	3.07	0.92	3.16	0.79	3.17	0.61	3.30	0.51	3.24	0.56
Perceived Potential	3.82	0.68	3.45	0.83	3.64	1.77	3.59	0.70	3.61	0.68	3.60	0.68
Sensory	3.25	1.03	3.04	0.95	3.15	0.99	3.24	0.74	3.31	0.78	3.28	0.75
Intention	3.15	1.21	3.16	0.96	3.15	1.09	2.97	1.04	3.30	0.69	3.14	0.88

Table 5 shows the means of the dependent variables for each experimental condition. The total means of the dependent variables sensory and attitude are lower in the neutral article condition than in the positive sensory information condition, whereas the means of the other dependent variables are nearly identical on both article type conditions.

The dependent variable perceived potential has the highest means in every experimental condition.

Hypotheses

A two-way ANOVA (table 6) was conducted to examine the effects of the additional positive information on the dependant variables attitude, perceived potential, beliefs on sensory characteristic and the behavioral intention of the participants towards In-Vitro-Meat.

Table 6: Two-way ANOVA results

Variables	**Article type**		**Facebook responses**		**Interaction**	
	F	*p-Value*	*F*	*p-Value*	*F*	*p-Value*
Attitude	0.39	.54	0.03	.87	1.25	.27
Perceived potential	0.07	.80	1.54	.22	1.94	.17
Sensory	0.57	.45	0.16	.69	0.63	.43
Behavioral Intention	0.01	.92	0.74	.39	0.64	.43

The two-way ANOVA shows that there is no statistically significant main effect of additional positive information on the dependent variables attitude, perceived potential, beliefs on sensory characteristics and the behavioral intention of the participants towards In-Vitro-Meat.

The first hypothesis, *Additional positive information will lead to a more positive attitude, perceived potential, beliefs on sensory characteristics and a higher behavioral intention towards In-Vitro-Meat,* has been rejected because there is no statistically significant result that supports this hypothesis.

The two-way ANOVA also shows that there is no statistically significant effect of the Facebook responses and the dependent variables attitude, perceived potential, beliefs on sensory characteristics and the behavioral intention of the participants towards In-Vitro-Meat.

The second hypothesis, *Positive responses on Facebook post will lead to a more positive attitude, perceived potential, beliefs on sensory characteristics and a higher behavioral intent towards In-Vitro-Meat,* has also been rejected because of the statistically insignificant results.

And the two-way ANOVA shows that the effect of the interaction of additional positive information and the Facebook responses is also statistically insignificant for the dependent variables attitude, perceived potential, beliefs on sensory characteristics and the behavioral intention of the participants towards In-Vitro-Meat.

The third hypothesis, *The combination of the additional positive information about the sensory characteristics of In-Vitro-Meat and the positive responses on the Facebook post will lead to a more positive attitude, perceived potential, beliefs on sensory characteristics and a higher behavioral intent towards In-Vitro-Meat rather than none or one of these conditions occur,* has also been rejected because of the statistically insignificant results.

Discussion

With the continued growth of the world population and its rapidly increasing food and meat consumption, it is of interest to explore alternatives for the consumption and production of meat. With the rate the population is growing, the world will not be able to keep up with the demands for meat. The United Nations population projections indicate that the global population could reach 9.15 billion in 2050 (Alexandratos & Bruinsma, 2012). In-Vitro-Meat (IVM) could be an alternative for the traditional meat production. The development of IVM is still in the early stages and it is not yet used for commercial purposes because of the high cost of the production (Bhat et al., 2017). The objective of this study is to examine, in an online experiment, if the attitude of people towards IVM can be influenced. The foundation of this study has been the Theory of Planned Behavior of Ajzen (1991).

The experiment is conducted with a focus on the influence of the subjective norm the participants perceive on their attitude towards IVM. The participants are randomly divided using a 2 by 2 design 2:
*(Additional positive information: [yes, no]) * 2 (Facebook post: [positive, negative])*.

All participants are given an article containing neutral information about IVM. Half of the participants are given additional positive information in the article, this is a positive explanation towards the sensory characteristics of IVM. All participants are randomly assigned a Facebook post, where the responses could be mainly positive or negative.

Conclusions

The additional positive information on the sensory characteristics of IVM had no significant effect on the beliefs on the sensory characteristics (texture and taste) of IVM. Nor, did it show a significant effect on the attitude towards IVM, the perceived potential or the behavioral intention towards the consumption of IVM. Solely providing the additional positive information about the sensory characteristics proves insufficient to have an affect on all the

dependent variables. The additional positive information alone might not be sufficient enough to change the beliefs and attitude towards IVM. Studies have demonstrated that taste exposure to novel food increases the liking for the taste in adults and willingness to eat more of the novel foods in children (Pliner, Pelchat, & Grabski, 1993). Exposure to real IVM might proof to be sufficient to influence the participants beliefs and attitude towards IVM.

The Facebook posts and responses show no significant effect on the dependent variables attitude, behavioral intention or beliefs on sensory characteristics. There is the possible that the participants perceived no enjoyment in reading the Facebook posts and responses. Current research shows that the perceived enjoyment is a major variable that can influence the participants acceptance of the online information given to them (Pornsakulvanich, 2017).

There was no significant effect in the interaction between both of the independent variables on the dependent variables attitude, beliefs on sensory characteristics, perceived potential and the behavioral intention towards IVM.

A manipulation check shows a significant correlation between the answers of the control question and the received manipulation. It also shows that there are no misinterpretations on whether the received Facebook posts were positive or negative. It is possible that the correlation between the answers of the control question and the received manipulation might have been higher with the use of a true-false question.

A mean analysis of the dependent variables for each experimental condition shows that the dependent variable perceived potential has the highest means in each experimental condition. The height of the means (> 3.45) of the dependent variable perceived potential indicate that, regardless of the experimental condition, on average the participants perceived that IVM has potential. This is a contradiction with the statements made by Vanhonacker et al. (2012) that the attitude of people towards traditional meat substitutes is mainly negative and that it is considered a barrier for adopting a new meat substitute.

In conclusion, the results of this study show that it is insufficient to change people's attitude, beliefs on sensory characteristics, perceived potential and their behavioral intention towards IVM by merely providing them with information. Also presenting additional positive information containing sensory characteristics of IVM proofs to be insufficient to influence these variables. Nor was the influence of the Facebook posts and responses sufficient to be of

influence on the dependent variables. Research suggests that real exposure and experience with IVM is necessary to influence people's attitude towards IVM. (Pliner et al., 1993).

Limitations

There are possible limitations to this study. The first possible limitation is that the Theory of Planned Behavior might not have been suitable for this study. There is the possibility that, because the theory isn't based on food consumption, the theory might not provides any value in examining the dependent variables behavioral intention or perceived potential. People might have limited control over the food they consume, this can be because they are not included in the decisions about food choices, they don't cook or they can't afford to buy specific foods.

The second possible limitation is the question if the additional positive information on sensory characteristics was persuasive enough to have an influence on the dependent variables. If this study is repeated in the future, it is recommended to provide the participants with more persuasive information than the additional positive information provided in this research.

Another possible limitation might be that the article provided to the participants might not contain enough sufficient information to form a proper opinion about IVM.

91 of 104 of the participants in this study are female. Even though there is no evidence that suggest that this may have an influence on the results of this study, it is recommended that in future research the demographic variable gender is around 50% male and 50% female. This might provide a more realistic reflection of society and more conclusive results.

The Facebook posts and responses that are used in this experiment might be a possible limitation. It is possible that these posts and responses are too short and unconvincing for the participants to be of influence. When repeating this study, it is recommended to use realistic and persuasive Facebook posts and responses. There is also the possibility that the outcome of this research might have been different with the use of another form of social media.

In conclusion, there is a real need for alternatives for traditional meat consumption in the future. It is therefore important to conduct more research about IVM and to examine how to influence the population's attitude, beliefs on sensory characteristics, perceived potential and their behavioral intention on In-Vitro-Meat.

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Appendix A

Article and the additional information, which is marked by the red box.

The search for alternatives for meat

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With the growing world population it is necessary to find alternatives for the consumption of meat. With the rate the population is growing, we will not be able to keep up with the demands for the meat consumption. The production of traditional meat uses a lot of resources. The production of in-vitro-meat is a good replacement for traditional meat because it uses a lot less resources than the regular meat production does.

In-vitro- meat is meat that is manufactured without the involvement of the killing of animals. It is manufactured through tissue-engineering technologies in a laboratory. The tissue used for in-vitro- meat can be collected from animals biopsy or animal embryos. Those tissue samples are then put into a culture media, where it will start to grow on its own. When grown enough, the meat will be processed and can be used to make a variety of meat, like burgers or nuggets.

And you might think that because in-vitro- meat is manufactured in a different way the taste and structure of this meat won't be good enough for me. Don't worry, the structure and texture of the meat are great and it tastes delicious. You can cook or grill this meat just as you would do with a regular burger. So you can enjoy a nice burger knowing that you are helping the animals and the environment.

Appendix B

The Facebook post with the positive responses.

Appendix C

The Facebook post with the negative responses.