



Situational appropriateness of meat products, meat substitutes and meat alternatives as perceived by Dutch consumers

Johanna E. Elzerman, Lenneke Keulemans, Rosalie Sap, Pieterneel A. Luning*

Food Quality and Design, Wageningen University, PO Box 17, 6700 AA Wageningen, the Netherlands

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ABSTRACT

The development of meat substitutes could contribute to a more sustainable food production system. Although the consumption of meat substitutes in the Netherlands has grown over the last decades, meat consumption stayed roughly the same. This led to the question of whether meat substitutes fit in the same usage situations as meat products do. Perceived situational appropriateness of meat, meat substitutes and other meat alternatives in different usage situations was studied using an item-by-use appropriateness survey. Products were presented via photographs and for each combination of product and situation, the appropriateness was rated on a 7-point scale. Personal information included the consumption of meat and meat substitutes and Food Neophobia. An exploratory survey was conducted in 2004 and an online survey in 2019.

Overall, meat products were perceived as more appropriate than their vegetarian equivalents (e.g. hamburger vs. vegetarian hamburger) in almost all situations. Meat alternatives (chickpeas, nuts) scored generally higher than meat substitutes on situational appropriateness. Age and gender affected appropriateness ratings: women and younger respondents gave higher ratings to meat substitutes and meat alternatives. Food Neophobia showed a small effect. Meat substitute consumption frequency was a predictor of overall appropriateness in 2019, where it was not in 2004. Results underpin that situational appropriateness and consumer characteristics should be taken into account in new product development of meat substitutes. Furthermore, meat alternatives like chickpeas and nuts could also contribute to the reduction of meat consumption.

1. Introduction

Over the last decades, it has become clear that worldwide food consumption and food production systems have a substantial impact on the environment. The livestock sector seems the most resource-intensive and polluting sector of the food industry since it has a big impact on greenhouse-gas emissions, use of fresh water and land (Global Agriculture, 2020; Godfray, 2019; Hallström, Carlsson-Kanyama, & Börjesson, 2015; Vinnari & Tapio, 2009). To specify, the production of beef in the livestock sector is the most burdensome practice as it uses about 70 per cent of the world's agricultural land (Van Zanten et al., 2018). Moreover, due to the still-growing world population, it is expected that global meat production will keep on growing for the next decades (Aiking, 2011; OECD-FAO, 2019). So, due to this environmental pressure and with the still-growing meat production and consumption in mind, a shift in our dietary behavior from an animal-based diet towards a more plant-based diet is an urgent need to be environmentally more sustainable (Aiking, 2011; Smil, 2002; Tijhuis et al., 2011). Numerous alternative

protein foods that can act as meat substitutes have been launched on the market and became widely available since the middle of the 20th century (Godfray, 2019; Shurtleff & Aoyagi, 2013). However, the adoption of meat substitutes by consumers is slow and many products are not meeting consumer demands since the texture and taste of those products do not always resemble the texture and taste of meat, as shown by own results (Elzerman et al., 2011, 2013, 2015) and others (e.g. Hoek, van Boekel, Voordouw and Luning, 2011; Hartmann & Siegrist, 2017).

Meat products are eaten as versatile components of the meal in different use situations (Elzerman et al., 2013). Sustainable alternatives to meat should therefore not only be appreciated by consumers but also fit in their daily lives. The meat substitutes should be appropriate in the use situations, the context, in which normally meat products would be eaten. The context in which food products are eaten influences product acceptance (e.g. King, Meiselman, Hottenstein, Work and Cronk (2007); Elzerman et al (2011); Hersleth et al. (2015); Jaeger and Porcherot (2017). Traditionally, both in the food industry as well as in food science, consumer testing often still focuses on the product alone and

* Corresponding author.

E-mail address: pieterneel.luning@wur.nl (P.A. Luning).

neglects the context. Reasons for this are that involving the context in consumer testing is time-consuming, costly and logistically more complex (Tuorila & Lahteenmaki, 1992; Meiselman, 2013). However, recent studies underlined the importance of context in consumer research (Piqueras-Fiszman & Jaeger, 2015; Jaeger et al., 2019). Context includes the social or situational context (i.e. where, when, how, with whom the food is eaten) or the meal context (i.e. which other foods accompany the food product when it is eaten) (Meiselman, 2008). Context also plays a role in the acceptance of unfamiliar and new foods. When it is difficult for the consumer to know what product characteristics to expect, contextual factors might be more important than when a familiar food is eaten. To illustrate, serving a familiar sauce with a novel food enhanced the willingness to try and the acceptance of the food by adults and children (Pliner and Stallberg-White, 2000). The acceptance of meat substitutes was also influenced by the meal context they were served in (Elzerman et al. (2011)). Situational and social context can influence consumer acceptance of novel foods as well. Social interaction has been shown to influence novel food consumption (López-Espinoza et al., 2007). Moreover, in a qualitative study on meat substitutes, consumers reported considering their family members' opinions when shopping for food (Elzerman et al., 2013). An exploratory survey in 2004 on the

Table 1
Demographic and consumption data of the respondents in the two surveys.¹

	2004-Survey n = 79	2019-Survey n = 388
<i>Gender</i>		
Male	22.8	21.6
Female	77.2	78.1
Other ³		0.3
<i>Age group (years)</i>		
17–24	48.1	37.7
25–34	10.1	13.4
35–44	15.2	7.7
45–54	8.9	22.4
55–64	16.4	12.4
65–74	1.3	5.2
75–84	0	1.3
<i>Lifestyle ('I describe myself as a...')³</i>		
Meat eater		27.8
Flexitarian (I refrain from eating meat at least 1 day/week)		52.5
Vegetarian (I never eat meat)		14.3
Vegan (I never eat animal-derived foods)		6.2
<i>Meat consumption (with a hot meal)</i>		
Never ²	–	19.3
Less than once a week	2.5	5.4
1–2 times a week	12.7	16.0
3–4 times a week	34.2	31.4
5 times a week or more	50.6	27.8
<i>Meat substitute consumption (with a hot meal)</i>		
	Group	
Never	Non-user	16.5
Tried only a few times	Light user	20.3
Less than once a month	Light user	17.7
1–3 times a month	Medium user	20.3
1–2 times a week	Medium user	20.3
3–4 times a week	Heavy user	5.1
5 times a week or more ³	Heavy user	–
<i>Food Neophobia Score (range 10–70)</i>		
Low (10–30)		16.9
Moderate (31–50)		83.1
High (51–70)		0

¹ Data are presented as percentages.

² Only non-vegetarian respondents participated in the 2004 survey.

³ Spaces that were left open were questions/answers that were not part of the 2004 survey.

appropriateness of meat substitutes indicated that also the situational context affected perceived appropriateness (unpublished data).

In the last fifteen years, however, meat substitute consumption has grown at a rate of 4–6%, up to 10% in 2019. Despite this increased popularity, the market share of meat substitutes is still low: a niche market with less than 2% of the meat market. An average Dutch household only spent 13 euro on meat substitutes, where 224 euro was spent on meat (Menkveld, 2019; Koot, 2019). Dutch meat consumption (as gross carcass weight) was stable at around 77 kg per person per year between 2005 and 2018 (Dagevos et al., 2019). In the meantime, more consumers were willing to decrease their meat consumption for environmental or health reasons (Consumentenbond, 2016; Sanchez-Sabate and Sabaté, 2019). The increased popularity of meat substitutes together with the increased motivation of consumers to mitigate their meat consumption led to the question of whether meat substitutes now fit better in the usage situations of Dutch consumers than fifteen years ago. The main objective was to explore the appropriateness of meat products, meat substitutes and meat alternatives in different usage-situations. The term meat products was used for unprocessed or processed meat from animals; meat substitutes were defined as products that were developed to be eaten instead of meat, and meat alternatives are other products that are often eaten as protein source in a vegetarian meals, such as pulses and nuts.

The underlying research questions were:

- 1) What is the perceived appropriateness of meat products, meat substitutes and meat alternatives across different usage situations?
- 2) Is there a difference in perceived appropriateness of meat products, meat substitutes and meat alternatives between various consumer groups based on personal characteristics?

The results of the 2019-survey were compared to the findings of the exploratory 2004-study to gain insight into changes in appropriateness of meat and meat substitutes over fifteen years.

2. Materials and methods

2.1. Meat products, meat substitutes and meat alternatives

Five meat products and their vegetarian equivalents (meat substitutes) were used: minced beef and vegetarian mince, chicken pieces and vegetarian stir-fry pieces, hamburger and vegetarian hamburger, smoked sausage and vegetarian sausage, steak and vegetarian steak. Two meat alternatives that do not resemble any meat product (chickpeas and nuts) were added to see if these products were different in situational appropriateness compared to the meat substitutes. The products were presented to the respondents as a photograph of the product on a plate (without other food items) together with the food name.

2.2. Surveys

An exploratory survey was developed and conducted in 2004, according to the item-by-use appropriateness method by Schutz (1994) and the situations that were used were based on the information that was generated during focus group discussions on meat substitutes (published in Elzerman et al., 2013). The 2019-survey was based on the 2004-survey, with some adaptations: a paper questionnaire was used in 2004, whereas in 2019 the online survey software QualtricsXM® was used to facilitate recruitment of respondents and completion of the questionnaire. Furthermore, a few products were different and the number of situations that needed to be rated were reduced in 2019 because some situations had shown very similar appropriateness ratings in the 2004 survey.

The 2019-survey consisted of 3 parts, in the first part an introduction was given, and demographic questions were asked. The second part included questions on the consumption frequencies of meat and meat

substitutes and on Food Neophobia (i.e. the tendency to avoid new foods) (Pliner & Hobden, 1992; Hoek et al., 2013). Respondents were also asked to indicate whether they considered themselves to be either a ‘meat eater’, ‘flexitarian’, ‘vegetarian’ or ‘vegan’. Flexitarian is a well-known, but broad term in the Netherlands and the definition ‘I refrain from eating meat at least one day a week’ was used (Verain et al., 2020). The third part measured the item-by-use appropriateness of various meat products, meat substitutes and meat alternatives in different situational contexts. All situational contexts focused on the domestic domain (i.e. consumption at home). The usage-situations were phrased as follows:

Usage situation:	Abbreviated in figures as:
‘when I eat with my family’	Family
‘when I want to prepare a special meal’	Special
‘when I eat with vegetarians’	Vegetarians
‘when I eat with friends’	Friends
‘when I eat alone’	Alone
‘when I cook for children’	Children
‘to add flavor to the meal’	Flavoring
‘when I have little time to cook’	little time
‘when I want to eat a healthy meal’	Healthy

A photograph of a food product (meat products, - substitute, or - alternative) was shown together with the food name and the question that accompanied each photograph was: how appropriate do you find this food item as part of the hot meal in the following situations? The respondents indicated their perceived appropriateness score on a 7-point scale, anchored with 1 = never appropriate and 7 = always appropriate. There was no reference to brand names or ingredients of the food items. The food items were all well known in the Netherlands, except for some of the meat substitutes.

A progress bar was added to stimulate respondents to finish the survey. An example of a page in the survey can be found in Part 1 of the [Supplementary Material](#).

A pretest was conducted among eleven respondents from different ages and educational levels to check for unclarities and duration of the survey. Based on the feedback, some minor corrections were made.

The survey was approved by the Social Sciences Ethics Committee of Wageningen University and Research.

2.3. Respondent recruitment

In 2019, a non-random convenience sample was used to collect data from respondents with various backgrounds. Recruitment took place via social media (LinkedIn, Facebook, Instagram) of the researchers and via flyers and other promotional materials in public buildings and shops. The survey and all information were in Dutch and the information in the flyers was aimed clearly to attract respondents who had experience with preparing a meal with meat and/ or meat substitutes. Criteria that had to be met to be included in the study were: a full completion of the survey and a minimum completion time of 260 s for meat-eaters, or of 200 s for vegetarians or vegans, since they were not asked to fill in the questions about meat products. A total of 388 respondents completed the whole survey and met the inclusion criteria.

The 79 Dutch consumers that completed the exploratory 2004-survey were recruited from a panel that had taken part in a Central Location Test (CLT) on meals with meat substitutes (Elzerman et al., 2011). These respondents were all non-vegetarians. Table 1 shows the demographics and consumption data of the respondents of the two surveys.

2.4. Data analysis

Data analysis was performed using IBM SPSS Statistics® Version 26. Mean appropriateness ratings and standard error of the mean (SEM) were calculated for every product in a specific situation. Meat products were compared to their vegetarian equivalents to get insight into how their item-by-use appropriateness profiles differed.

Repeated measures analysis of variance (ANOVA) was used to identify significant differences between the mean item-by-use appropriateness ratings. For the difference between consumer groups, repeated-measures ANOVA was performed with the consumer group (e.g. meat substitute consumption or Food Neophobia) as a factor. The Greenhouse-Geisser correction was applied if the assumption of



Fig. 1. Mean item-by-use appropriateness ratings for five meat products (hamburger, chicken pieces, steak, smoked sausage and minced meat) and their vegetarian equivalents (meat substitutes) (1A through 1E) and for two meat alternatives (chick peas and nuts) and stir fry pieces (1F), as perceived by non-vegetarian respondents (n = 309). Situations with *** are significantly different between products at p < 0.001; ** at p < 0.01; * at p <



0.05

sphericity was violated (as tested using Mauchly's test of sphericity). Contrasts were calculated using a Sidak correction and effects were reported as significant at $p < 0.05$. Spearman's Rho coefficient was calculated to see whether there was a significant correlation between appropriateness ratings and a consumer characteristic (meat substitute consumption, Food Neophobia Score, or age). One-way ANOVA and independent t-tests were used to compare the means of gender or of the different years (2004 and 2019). A correction for multiple comparisons was applied. Also, an overall appropriateness score (i.e. mean appropriateness rating for all meat substitutes together and based on all

situations for every respondent) was calculated and simple linear regression was performed to predict overall appropriateness scores based on meat substitute consumption frequency. For this, we used the seven categories of meat substitutes consumption frequency (displayed in Table 1).



Fig. 2. Mean item-by-use appropriateness scores of the meat substitutes, as rated by non-, light-, medium- and heavy users of meat substitutes. 2019-Survey, all respondents included (N = 388). Situations with *** are significantly different between consumption groups at $p < 0.001$; ** at $p < 0.01$; * at $p < 0.05$.

3. Results

3.1. Item-by-use appropriateness of meat products, meat substitutes and meat alternatives

The mean appropriateness ratings per usage situation for every product were calculated and plotted to see the differences in appropriateness patterns between products (Fig. 1). Spider plots 1A through 1E show how meat products were rated compared to their vegetarian equivalents, whereas 1F compared meat alternatives (chickpeas, nuts) to the highest scoring meat substitute (stir fry pieces). When looking at specific situations, meat products did not score higher than meat substitutes in all situations. For the situation ‘when I want to eat a healthy meal’, the vegetarian hamburger was rated significantly higher than the normal hamburger. However, the smoked sausage also rated low on this situation, but so did the vegetarian smoked sausage. Also, on the situation ‘when I want to prepare a special meal’, hamburger and smoked sausage were not rated higher than their vegetarian equivalents. These products were not considered very special, according to their appropriateness scores. Contrarily, the steak was highly appropriate when a special meal was prepared and for adding flavor to the meal and when eating with friends. The vegetarian steak was given much lower ratings to all these situations. The meat alternatives (chickpeas and nuts) generally scored higher than the meat substitutes. Nuts were perceived as more appropriate than stir fry pieces in all situations, except for ‘when I cook for children’ and ‘for vegetarians’, where stir fry pieces were found equally appropriate. Chickpeas followed a similar pattern as stir fry pieces, but with higher appropriateness for ‘when I want to eat a healthy meal’ and lower appropriateness for ‘when I cook for children’.

3.2 Importance of personal characteristics

3.1.1. The influence of gender, age and food neophobia

Men tended to rate the appropriateness of meat products slightly higher than women. Out of the 45 possible combinations of meat products and situations, 22 were rated as more appropriate by men (49%). The other situations showed no significant difference between men and women. Appropriateness of meat substitutes, however, were rated lower by men in nine situations (20%), but higher in two situations (4%). Out of all nine situations, chickpeas were rated lower by men in four cases (44%) and nuts in seven cases (78%) (see Part 3 of Supplementary Material).

Also, the age of the respondents seemed to influence the

appropriateness scores. About 51% of the appropriateness ratings for meat substitutes was negatively correlated with age, whereas 53% of the ratings for meat products was positively correlated with age. The data indicated that older respondents tended to give lower appropriateness ratings to meat substitutes and higher ratings to meat products. This effect of age was only weak ($-0.3 < r_s < -0.1$ for meat substitutes and $0.1 < r_s < 0.3$ for meat products, $p < 0.05$). Surprisingly, a medium negative effect was found for both hamburger and vegetarian hamburger in the situation ‘when I eat with friends’, indicating that older respondents found a hamburger or a vegetarian hamburger in this situation less appropriate than younger respondents ($r_s = -0.38$, $p < 0.001$ and $r_s = -0.34$, $p < 0.001$ respectively, see Part 4 of Supplementary Material).

The tendency to avoid new foods, measured by the Food Neophobia Score (FNS) showed negative, but weak correlations in some situations for meat substitutes and meat alternatives ($-0.3 < r_s < -0.1$, $p < 0.05$), whereas positive, weak correlations were found for meat products ($0.1 < r_s < 0.3$, $p < 0.05$). This indicates that more neophobic respondents gave slightly higher ratings to meat products and slightly lower ratings to the appropriateness of meat substitutes and meat alternatives in some situations (Part 5 of Supplementary Material.)

3.1.2. The influence of usage frequency of meat and meat substitutes

To further explore how the consumption of meat substitutes relates to the situational appropriateness of these products, we calculated the mean appropriateness ratings for different meat substitute consumption groups (non-users, light-users, medium-users and heavy-users). Fig. 2 depicts the item-by-use appropriateness ratings for each meat substitute for these consumption groups. A clear pattern of higher appropriateness ratings for the more frequent meat-substitute users was found for all meat substitutes. Striking is that the appropriateness pattern for every product was comparable for each user group. The more often a respondent consumes meat substitutes, the higher a meat substitute was rated on item-by-use appropriateness. From the meat alternatives, chickpeas showed a similar pattern, but nuts showed only a low effect of meat substitute consumption frequency. Nuts received quite high ratings from the light, medium and heavy users, and only the non-user group rated all situations significantly lower than the other groups (see Part 6A of Supplementary Material).

This relation between meat substitute consumption frequency and appropriateness ratings was confirmed by Spearman’s Rho correlation coefficients, that showed mostly medium ($r_s > 0.3$; $p < 0.01$) and high

Table 2

Comparison of mean appropriateness ratings for five meat products, four meat substitutes and one meat alternative.^{1,2,3}

Usage Situation	Year	Hamburger		Chicken pieces		Sausage		Mince		Steak	Nuts
		Meat	Meat substitute	Meat	Meat substitute	Meat	Meat substitute	Meat	Meat substitute		
Family	2004	4.8	4.1	5.9	4.7	5.3	4.0	6.0	4.4	4.9	5.0
	2019	5.3	4.3	5.9	4.4	5.0	3.8	5.7	4.3	4.6	4.7
Special	2004	2.5	2.6	4.6	3.4	3.1	2.6	4.0	2.9	6.1	5.3
	2019	3.0	2.9	4.7	3.5	2.9	2.6	4.0	3.2	5.6	5.0
Vegetarians	2004	1.2	5.8	1.2	6.2	1.2	5.7	1.1	5.9	1.2	6.3
	2019	1.6	5.5	1.8	5.6	1.5	5.1	1.6	5.6	1.4	5.5
Friends	2004	3.5	3.1	5.3	3.9	4.2	2.9	5.1	3.6	4.6	5.1
	2019	4.4	3.8	5.3	4.0	3.9	3.2	4.8	3.9	4.6	4.7
Alone	2004	4.2	4.0	5.1	4.4	3.6	3.2	4.8	3.3	4.1	4.4
	2019	4.5	4.1	5.1	3.9	3.6	2.9	4.6	3.7	3.7	4.7
Children	2004	5.5	4.7	5.5	4.1	5.4	4.3	5.5	4.1	3.7	3.5
	2019	5.0	4.2	5.4	4.0	4.6	3.5	5.2	4.0	3.1	3.8
Flavoring	2004	3.8	3.4	4.6	3.3	5.0	3.8	5.3	3.2	4.9	5.0
	2019	3.9	3.3	4.7	3.5	4.3	3.1	4.6	3.3	4.5	4.9
Little time	2004	5.1	4.6	4.9	4.5	4.7	4.3	5.1	4.1	4.2	4.1
	2019	4.9	4.2	5.1	4.0	4.2	3.4	5.0	3.9	3.3	4.3
Healthy	2004	2.5	3.9	4.9	5.0	2.9	3.6	4.0	4.2	4.6	5.0
	2019	2.9	3.9	5.3	4.3	2.8	3.2	4.1	4.1	3.9	5.3

¹ The vegetarian steak was not yet available, and chickpeas were not tested in the 2004-survey and are therefore not part of this comparison.

² SEM was between 0.08 and 0.23 for 2004 and between 0.06 and 0.12 for 2019.

³ Differences between the years 2004 (N = 79) and 2019 (N = 309) are written in italic and bold ($p < 0.05$); only non-vegetarian respondents were included.

($r_s > 0.5$; $p < 0.01$) correlations for combinations of meat substitute and situation (see Part 6B of [Supplementary Material](#)). This means that the more often respondents consume meat substitutes, the higher they tend to rate the appropriateness of a meat substitute in a usage situation. When only non-vegetarian respondents (i.e. the respondents who describe themselves as a ‘meat eater’ or a ‘flexitarian’) are considered, the same pattern, but with somewhat lower correlation coefficients, was found (Part 6C of [Supplementary Material](#)).

Significant negative, but weak correlations ($r_s < -0.1$) were found between meat substitute usage frequency and most meat products in a particular usage situation, indicating that the more often meat substitutes are eaten, the *lower* the appropriateness ratings of meat products were (all p -values < 0.05) (see Part 6B of [Supplementary Material](#)).

3.2. Differences between the 2019- and 2004-surveys

To compare the current study with the exploratory study of 2004, we analyzed the differences in appropriateness ratings. [Table 2](#) shows the significant differences between the mean appropriateness ratings of the meat products, meat substitutes and meat alternatives for the nine usage situations between the years 2004 and 2019. Only the non-vegetarian respondents were included from the 2019-survey, because the 2004-survey was only conducted among non-vegetarian consumers. Overall, the mean appropriateness ratings of meat products, meat substitutes and meat alternatives were similar between the 2004- and the 2019-surveys. Regarding the meat substitutes, only a few significant differences were found, and in those cases, the mean appropriateness rating for the 2019-survey was significantly *lower* than the rating in the 2004-survey. For the meat products, both a few positive and negative differences were found between 2019 and 2004.

Looking at the consumption of meat substitutes in both years, 48.8% of the meat-eating respondents in 2019 were medium users of meat substitutes (compared to 40.6% in 2004) and 7.4% were heavy users (compared to 5.1% in 2004). This higher usage-frequency was not reflected in the results. Besides, the meat consumption frequency of the non-vegetarian respondents in the 2019-survey was lower than in the 2004-survey: 35.0% in 2019 ate meat with a hot meal on at least 5 days a week (50.6% in 2004) and 39.5% on 3–4 days a week (34.2% in 2004), 19.4% ate meat on 1–2 days a week (this was 12.7% in 2004).

To get more insight into the similar appropriateness ratings in 2004 and 2019, we looked at how meat substitute consumption frequency could have influenced the appropriateness ratings in those years. For this, we calculated for every respondent an overall mean appropriateness rating for all meat substitutes together and based on all situations. A simple linear regression was calculated to predict overall appropriateness scores for meat substitutes based on meat substitute consumption frequency. We did not find a significant regression equation for the 2004-survey, indicating that meat substitute consumption frequency could not explain the appropriateness ratings in the 2004-survey. To be able to compare the two surveys, only the non-vegetarian respondents from the 2019-survey were used in the calculation, and a significant regression equation was found $F(1, 307) = 110.683$, $p < 0.001$ with an R^2 of 0.265. This indicates that meat substitute consumption frequency accounted for 26.5% of the variation in overall appropriateness ratings of meat substitutes in the 2019-survey.

4. Discussion

In the survey presented here, we investigated the perceived situational appropriateness of meat substitutes, meat alternatives and meat products to discover how these products relate to each other in terms of suitability for usage in daily life. This information could be used in the first steps of new product development and marketing strategies for meat substitutes.

Our findings showed that the situational appropriateness was different for the meat products, meat substitutes and meat alternatives

that were assessed. The appropriateness scores for most situations were higher for all meat products compared to their vegetarian equivalents ([Fig. 1](#)), meaning that overall, meat substitutes were not considered as appropriate as meat products in the usage situations we tested. The versatility of meat products seemed higher than of meat substitutes. However, in some situations, the meat substitute was perceived as more appropriate than the original meat product, e.g. for a ‘healthy meal’, in the survey of 2019 as well as 2004. This confirms that healthiness is one of the drivers of meat substitution. This was also found in a survey by [Hoek et al \(2011\)](#) that showed that mainly consumers who consumed meat substitutes at least once a week perceived meat substitutes as healthier than meat. That study also showed that meat was more suitable for special occasions, something that can be concluded from our study as well, where, for example, the steak was highly appropriate when a special meal was prepared and for adding flavor to the meal and when eating with friends. The vegetarian steak was given much lower ratings to all these situations. An explanation could be that consumers categorize meat substitutes with ‘processed’ products and a steak with ‘unprocessed’ meat ([Hoek et al., 2011](#)). Therefore, the expectations of steak and vegetarian steak could be essentially different. An additional explanation could be that the sensory expectations of the relatively new vegetarian steak were based on sensory experiences with other meat substitutes and these could simply not meet the highly appreciated sensory standards of steak.

Another interesting outcome of the study was that the meat alternatives (chickpeas and nuts) generally scored higher than the meat substitutes. Especially nuts are considered quite appropriate in all situations. From a sustainability perspective, this is a positive outcome, as pulses and nuts only need minimal processing. Contrarily, the production of most meat substitutes still requires energy-intensive processing that reduce potential sustainability gains ([van der Weele et al., 2019](#)).

When looking at the personal characteristics of the respondents, the personality trait food neophobia showed only a weak effect on appropriateness ratings in the current research (see Part 5 of [Supplementary Material](#)). A reason for this can be that the majority of the consumers included in this research were relatively food neophilic, which means that they generally liked to try new foods. Other studies concluded that food neophobia was sometimes, but not always linked to reduced perceived appropriateness ratings and acceptance of novel food products ([Schickenberg, Van Assema, Brug, & de Vries, 2008](#); [Verbeke, 2015](#); [Jaeger et al., 2019](#)). More specifically, low levels of acceptance of meat substitutes have been associated with food neophobia and current consumers of meat substitutes tend to be less neophobic ([Apostolidis and McLeay, 2016](#), [Giacalone, 2019](#)). Another possible explanation for the weak relationships that we found between food neophobia and appropriateness ratings could be that not all protein foods included in the current research were relatively new on the Dutch market anymore. To specify, almost one-third of the consumers used meat substitutes and other protein-rich products once or twice a week. The consumers might be knowledgeable about the protein foods and repeated exposure (through consumption, media and word of mouth) may have created familiarity. Consequently, the previous experience with the protein foods was likely to affect the situational appropriateness evaluations more than the level of food neophobia did.

Furthermore, the differences between the meat substitute consumption groups in the 2019-survey were quite distinct; ‘heavy users’ of meat substitutes gave higher appropriateness ratings to meat substitutes ([Fig. 2](#)) and meat alternatives (Part 6A of [Supplementary Material](#)) than ‘medium’, ‘light’ or ‘non-users’. Situational appropriateness was medium to highly correlated to ‘meat substitute consumption group’ for most situations (Part 6B of [Supplementary Material](#)). These differences in perceived appropriateness between meat substitute consumption groups were also found when only the non-vegetarian respondents ($n = 309$) were taken into consideration (Part 6C of [Supplementary Material](#)), meaning that the results were not too much influenced by the vegetarian respondents, who usually tend to eat meat substitutes more frequently

than non-vegetarians. Familiarity heuristics could explain this positive correlation, because the more frequently a consumer uses a certain product, the more it will become familiar to that consumer. Several studies by Giacalone and Jaeger (2016) showed that familiar products were perceived as appropriate for a wider range of uses, which may be explained by the consumers' expectations of the sensory properties and safety of the products. We could not establish a causal relationship from our results. It could also be that respondents who generally find products more appropriate in usage situations, adopted meat substitutes into their lifestyles.

The same pattern between meat substitute consumption frequency and appropriateness ratings was also found in a study where respondents had to rate the appropriateness of meat substitutes in a meal context (Elzerman et al., 2015). In all types of meal contexts, i.e. different dishes, a clear increase in mean appropriateness ratings from non-, light, medium to heavy users of meat substitutes was found, even though the usage frequency of the heavy users was only 'at least once a week'. Repeated exposure has also been shown to increase the acceptance of meat substitutes. A home-use test of 10 weeks found a 'mere exposure effect' for meat substitutes for some respondents, where liking increased after repeated consumption of a meat substitute (Hoek et al., 2013). Moreover, consumers' familiarity with a product is related to higher situational appropriateness ratings, as summarized and elaborated by Giacalone (2019).

The appropriateness scores between the 2004- and 2019-surveys were surprisingly similar (Table 2). We expected to find higher overall appropriateness scores for meat substitutes in 2019 than in 2004, because of the longer exposure of consumers to meat substitutes over the years, the larger assortment in the supermarkets and the greater attention in the media for meat substitution. However, this difference was not found. In contrast, mean appropriateness ratings of the meat substitutes by non-vegetarian respondents in 2019 were slightly lower than the ratings in the 2004-survey. However, further investigation of the two surveys with regression analyses showed that the overall appropriateness ratings in 2019 could be predicted from the usage frequency of meat substitutes and this was not the case in 2004. This means that in the 2004-survey, the more frequent users of meat substitutes did not give higher appropriateness ratings than the non- and light users. The non-users in 2019 gave much lower ratings than the non-users in 2004 and the heavy-users in 2019 rated overall much higher than the heavy users in 2004. It should be noted that there were less 'heavy users' of meat substitutes in the 2004-survey.

What could be the reason for this (in)dependence between appropriateness and meat substitute consumption frequency? In 2004, there was a much smaller variety of meat substitutes on the market (Elzerman, 2006; Hoek, 2006). Also, there was less attention to these products in the media. Appropriateness ratings of the non- and light users of meat substitutes in the 2004-survey might have been based on their image of these products and not on actual experience. The respondents who chose to participate in our study in 2004 probably had a positive attitude towards these products and this resulted in the relatively high appropriateness ratings of these consumption groups. In the 2019-survey, however, the low ratings that non- and light users gave might have been caused by a bad sensory experience with meat substitutes that these respondents once had and therefore they rejected the product category as a whole. A model on insect-based burgers shows that adoption of such a product is a result of sensory expectations and appropriateness, as experienced in previous tasting opportunities (Horvat et al., 2020). The fact that meat substitutes are positioned as a product to replace meat, means that consumers compare these products to meat, despite their sensory properties that often cannot yet compete with meat. Furthermore, it can take a long time before a 'rejecter' of a product finally gives the product a second chance and accepts it after all (ibid). Another explanation could be that some consumers just do not see the necessity of the replacement of meat and mainly focus on taste and culinary experience and that meat-eaters have very strong and persistent beliefs

about the role of meat in daily life (Schösler, 2012; Hoek, Luning et al., 2011). The higher appropriateness ratings of heavy users of meat substitutes in 2019 reflect that these consumers have adopted meat substitutes in their lifestyles and probably also that they do not keep comparing the properties of these products to the meat properties (anymore). Also, the need for meat in these consumer groups seems less, as can be concluded from the negative correlation between the appropriateness of meat products with meat substitute consumption. Ethical reasons like animal welfare, environmental concerns could play a stronger role now to more consumers than in 2004 (Apostolidis and McLeay, 2016).

Contextual factors were part of this study to learn about determinants beyond liking in the acceptance of meat substitutes. This information on situational appropriateness could guide product developers in the early stages of new product development. However, our research is not without limitations. Mainly practical reasons led to the present surveys using photographs, food names and description of the situations. Although the usage of 'immersive settings', i.e. well-defined descriptions of usage contexts can increase the ecological validity of a study (Jaeger and Porcherot, 2017), it could be that our context descriptions were too limited and not always applicable to (some of) our respondents (e.g. 'when I cook for children' or 'when I eat with vegetarians'). Furthermore, from the photographs of the products some respondents might have known exactly what product it was and based their answers on that specific product, whereas for others, the photograph represented the product category.

Our recruitment was performed via flyers in supermarkets and public buildings, as well as social media of the researchers. Although we aimed for a diverse consumer sample with naturalistic distribution of gender, age, consumption behavior and FNS, many young, neophilic women took part in our study. The exploratory 2004-survey was completed by respondents who had already taken part in a central location test on meat substitutes. Therefore, their recent experience with meat substitutes could have influenced the results. Furthermore, the small consumer sample from 2004 ($n = 79$) limits a thorough comparison between the two surveys.

5. Conclusions

This paper shows that situational appropriateness of meat substitutes is still lower than that of meat products. However, when familiarity with these products increases, so does the perceived situational appropriateness. Non-users of meat substitutes in 2019 had lower ratings than the non-users in 2004. Attention in product development and marketing should be paid to consumers that are now non-users of meat substitutes as different products and/or marketing techniques could be necessary for this group. Appropriateness should be taken into consideration in the development of new products aimed to replace meat.

CRediT authorship contribution statement

Johanna E. Elzerman: Conceptualization, Methodology, Investigation, Formal analysis, Visualization, Writing - original draft. **Lenneke Keulemans:** Methodology, Investigation, Formal analysis. **Rosalie Sap:** Methodology, Investigation, Formal analysis. **Pieter A. Luning:** Conceptualization, Methodology, Writing - review & editing, Supervision.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.foodqual.2020.104108>.

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