

Review

Opportunities for the Adoption of Health-Based Sustainable Dietary Patterns: A Review on Consumer Research of Meat Substitutes

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Received: 14 May 2019; Accepted: 22 July 2019; Published: 25 July 2019



Abstract: This article reviews empirical research on consumers' adoption of meat substitutes published up to spring 2018. Recent meat substitutes often have sustainable characteristics in line with consumers' concerns over aspects of healthy food and the environmental impact of food production. However, changing lifestyles with less time for cooking, any transition from a strongly meat-based to a more plant-based diet depends on the successful establishment of convenient meat substitutes. This article reviews the growing body of research on meat substitutes. These research articles were classified into five different stages in line with the innovation-decision process of: knowledge, persuasion, decision, implementation and confirmation. The research was analysed both quantitatively and qualitatively, with results suggesting that although health, environmental and animal welfare aspects can persuade consumers and influence their decision to try a meat substitute, the appearance and taste of those meat substitutes are crucial factors for their consumption on a regular basis. However, there still remains a gap in research articles focusing on the regular consumption of meat substitutes.

Keywords: Plant-based diet; sustainability transition; consumer acceptance; literature review

1. Introduction

Sustainability aspects of food consumption are manifold and typically subdivided into three dimensions: ecological, social and economic [1–3]. However, in more recent work, a fourth dimension has been added; that of health [4]. Many novel foods have a focus on sustainability in line with consumers' concerns over health aspects and the environmental impact of food production, especially of meat and dairy products. In recent sustainability research, the health dimension has gained more attention. Although moderate consumption of red meat might play a positive role in cancer prevention [5], overly high meat consumption is thought to have negative impacts on human health [6–8]. In industrialised countries, high consumption levels of energy-rich foods are still increasing, including the consumption of meat, milk, and other dairy products [9]. Consequently, the intake of monosaccharides and saturated fat is also increasing (ibid.). A partly vegetarian diet, e.g., one or two meat-free meals per week, would prove advantageous nutritionally [10,11]—not only concerning health aspects [12], but also in environmental terms [13]. In this context, a meat substitute can be anything a consumer eats in place of conventionally produced meat, so reducing the environmental burden of his or her diet. There has already been initial research into the barriers to establishing meat substitutes in consumption patterns [14–18]. The challenge that researchers and product developers face is the transition from animal-protein-based nutrition to a diet containing, for example, meat substitutes made from plant proteins [19].

Therefore, the aim of this paper is to review consumer research dealing with consumers' adoption of meat substitutes. After embedding the review in a theoretical framework, materials and methods are presented. The results of the articles reviewed are then described by quantification of subcategories combined with a narrative review. Finally, future areas of research are suggested and conclusions drawn.

2. Theoretical Framework

The development and introduction of food innovations, in this case meat substitutes, pass through several stages [19]. A basic idea of a meat substitute is an unprocessed substitute, e.g., from vegetable or pulses, for example. A more convenient meat substitute is a processed product, which mostly contains a protein component. Before preparing the introduction of such a food innovation, the respective food technology must be developed and made available. However, such food-technology as well as legal requirements must be fit for purpose.

There is already much research on meat substitutes; however, there is no meat substitute that has been established on the worldwide market. Although many meat substitutes have been launched and conventional meat substitutes such as lentils are well known, regular consumption is still low. Rogers' model might be an appropriate approach to find out why meat substitutes are often not successful long term on the food market or are not consumed regularly. The decisive factor for a successful product launch of an innovative food is consumer-related preferences and willingness to pay (WTP), plus a surplus for the added value of product innovation [20,21]. This means that before the product launch, market research is necessary in order to estimate the product's potential. These results can also indicate how the introduction of product innovations can be influenced positively (e.g., by means of market operations such as information campaigns etc.). However, despite thorough preparation, there has been a high rate of failure (65–90%) with innovative food introductions [22]. This could be caused by a lack of consumer understanding, insufficient market orientation from the producers' point of view or food neophobia [23]. The risk of a meat substitute not succeeding in the food market can be reduced by careful market research into target consumer segments and especially the innovator segment [24]. Consequently, this article focuses on consumer research.

Consumers' adoption of meat substitutes is based on an innovation-decision process [19]. This model could be adapted to determine whether a consumer decides in favour of a meat substitute or rejects it. Following Rogers [19] (1995, p. 206 et seq.), five different stages can be identified during this innovation-decision process. These stages are described in more detail below and illustrated in Figure 1, which applies the innovation-decision process to meat substitutes.

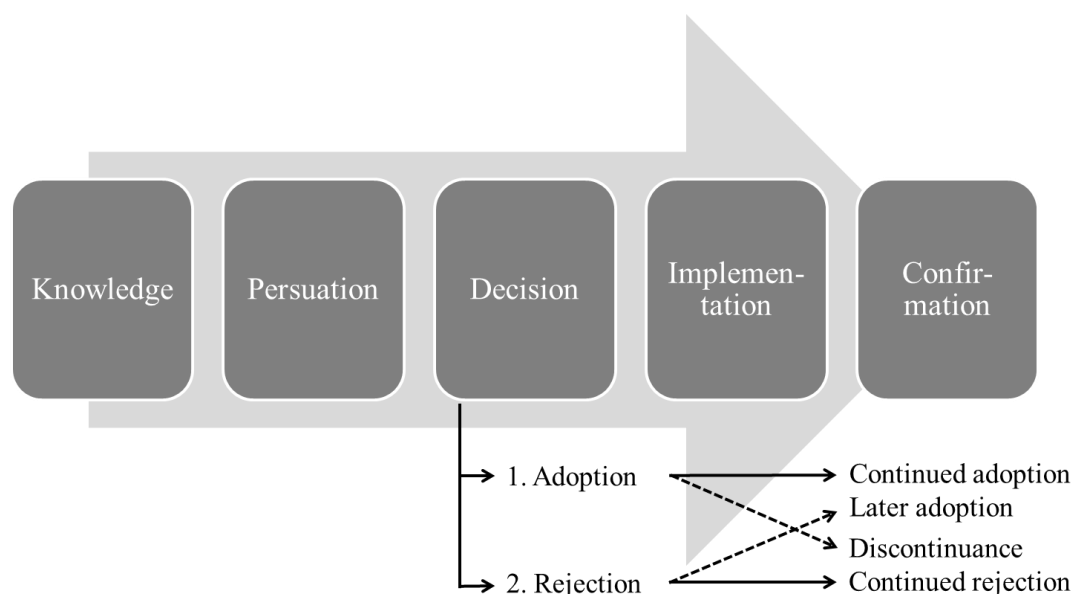


Figure 1. Model of stages in the innovation-decision process applied to meat substitutes.

The Source of the above figure comes from my own presentation based on Rogers [19] (p. 163)

1. Knowledge: the consumer learns about the meat substitute. Besides knowledge about the innovation itself, the consumer might also learn the basic principles of the meat substitute, e.g., the key ingredient.
2. Persuasion: the consumer forms a favourable or an unfavourable attitude towards the meat substitute. This can be due to personal characteristics or due to information transfer, either self-induced or externally induced.
3. Decision: the consumer chooses to adopt or to reject an innovation in deciding to try or not to try a meat substitute that he or she has never tried before.
4. Implementation: the consumer adopts the meat substitute. There has to be differentiation between the decision to adopt a meat substitute and to consume that meat alternative regularly in everyday life.
5. Confirmation: consumers sometimes revise decisions. In the confirmation stage, the consumer might stop consuming the meat substitute or, vice versa, a non-adopter might decide to try the meat alternative having previously decided not to do so.

To learn more about the diffusion process and to improve an understanding of consumer behaviour in terms of new product introductions research should be carried out in all five stages, which accompany the introduction of a meat substitute. To date however, no review of consumer research on meat substitutes embedded into a theoretical framework has been carried out. This review therefore offers important insights into the current state of research on all five stages of the innovation-decision process.

3. Material and Methods

The analysis presented here is based on a thorough literature review. As a first step databases were screened followed by a quantitative evaluation of those scientific papers identified in what became the second step. Third, the relevant literature was categorised in accordance with the five stages of the innovation-decision process described above.

As the focus of this review, the diffusion of meat substitutes was the search term “meat substitute*” in combination with consum*. The wildcard “*” was used as a substitute for the capture of consume, consumer, consumption etc./substitute, substitutes, all of which are relevant. Seven international databases were scanned thoroughly: AgEcon, EBSCO, EconPapers, Emerald Insight, NAL Catalogue, ScienceDirect and Web of Science—as suggested for example by Hemmerling et al. [25] or Rödiger and Hamm [26]. There was no temporal restriction to the literature review. The oldest article included is from 1975 and the most recent one from 2017.

All hits were organised in an Excel spreadsheet that included information on the author, the year of publication, the journal, the title of the paper, the abstract, keywords, in which data-base and with which search terms the paper was found. Duplicates were eliminated. In a next step, the spreadsheet was complemented by the decision whether or not to include the paper in the review based on its relevance. This was followed by quantitative and qualitative analyses of the hits.

The literature search delivered 204 hits. After reading the abstracts, 144 of these hits were found to be irrelevant for the aim of this literature review (see above). Reasons for exclusion from the review were mainly due to:

- A focus on life-cycle assessment that does not include consumer research
- A technical focus which does not include consumer research as well
- A focus on nutritional physiology which does not explain why consumer decide for or against a meat substitute
- Studies that were not in English language were excluded due to language barriers for a majority (French, German, Polish, Spanish, Turkish)

- Only studies with primary data were included, i.e. consumer studies. Studies based on secondary data or reviews were excluded.

Of the remaining 60 papers, each full paper was downloaded or requested from the author(s) where there was no access to the full paper. Six articles could not be obtained as no contact details of the author(s) were found. After 28 days, full papers that were not accessible were excluded from the literature review ($n = 5$). A further 22 articles were not included after full text screening as the focus of those papers was not on consumer research.

Consequently, 27 articles available with a full text version were included in the literature re-view. These papers have been categorised in line with the theoretical framework. Table 1 gives an overview of the categorisation. If papers referred to more than one stage of the innovation-decision process, the chosen category related to the result that predominated in the respective paper.

Table 1. Number of publications per category of consumer research.

Search Term	Number of Publication	Category	Number of Publications
"meat substitute*" AND consum*	N = 27	Knowledge	3
		Persuasion	9
		Decision	7
		Implementation	8
		Confirmation	-

Source: Own data.

Of course, the body of scientific publications is growing. Global scientific output grows 3% every year and the number of publications doubles approximately every 24 years [27]. Product innovations are often found in saturated food markets as they allow companies to gain market share and to increase profits [28], with meat substitutes becoming especially popular over the past 10 to 15 years. As a result, the number of publications concerning the introduction of meat substitutes has risen over recent years. In the 1970s there was just one publication, focusing on research on meat substitutes starting in the 2000s. In 2015 and 2016 there were four publications on meat substitutes in each year. This trend can be seen in Figure 2.

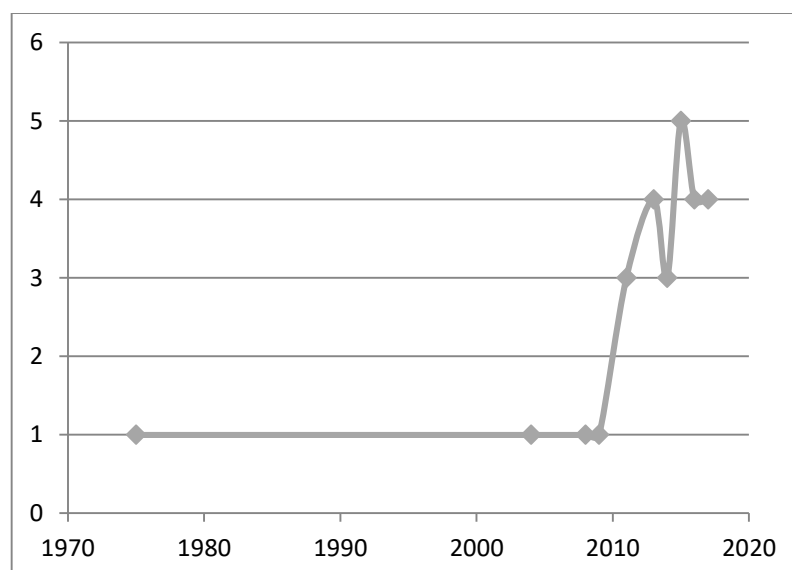


Figure 2. Number of publications per year (Note: For 2018, only publications until February are included; Source: Own data).

An overview with key aspects of the 27 included research articles can be found in Table 2.

Table 2. Overview of the included research articles.

Author(s), Year of Publication	Country of Data Collection, Sample Size	Survey Design; Method	Type of Meat Substitute	Main Theory	Research Question	Main Conclusion	Category
Apostolidis and McLeay, 2016a	UK, 247 consumers	Questionnaire; discrete choice experiment	Plant-based meat substitutes	Random Utility Theory	Which role can plant-based meat substitutes play in the policy agenda?	Latent class analysis identified six consumer segments: price conscious, healthy eaters, taste driven, green, organic and vegetarian consumers that should be addressed differently	Decision
Apostolidis and McLeay, 2016b	UK, 32 vegetarians, meat reducers and meat eaters	Group interview sessions; content analysis	Mycoprotein products	Means-end chain approach; Schwarz's theory of basic values	How can values and benefits influence consumers' preferences for meat substitutes?	Most consumers associated Mycoprotein products with health and sustainability-related benefits driven by values of security, benevolence and universalism	Persuasion
Barsics et al., 2017	Belgium, 135 undergraduate students	Taste testing session; generalised linear model, Wilcoxon-Mann-Whitney ranked sum tests	Insect-based products	N/A	Would a broad-based information session affect consumers' perceptions and attitudes about an edible insect product?	Information about insect-based products can change consumers' perceptions of insect products	Knowledge
Bosman et al., 2009	South Africa, 2,437 consumers (Whites, Blacks, Coloureds and Indians)	Questionnaire; univariate and bivariate methods	Soy products	N/A	What are South African consumers' attitudes to soy products?	More than 60% of the population within all race groups were positive about soy and found soy to be a good source of protein with health benefits and agreed that soy can replace meat	Implementation
Cicatiello et al., 2016	Italy, 201 consumers	Questionnaire; logistic regression	Insects	N/A	What are Italian consumers' attitudes to insects as food?	Familiarity with foreign food as well as higher education and male gender positively influenced to consume insects	Persuasion
De Boer et al., 2014	The Netherlands, 1,083 consumers	Questionnaire; regressions	Generic	N/A	Which are change strategies that may help to reduce animal protein consumption and replace it by plant proteins?	Different strategies to change meat eating frequencies and meat portion sizes were described according to consumer segments and corresponding preferences	Implementation
De Boer et al., 2017	The Netherlands, 707 (native Dutch, n = 357, second generation Chinese Dutch, n = 350)	Questionnaire; regressions	Generic	Self-Determination Theory	What is the motivation for different diets (young self-declared vegetarians, low, medium and high meat-eaters)?	Different from high meat eaters, for low and medium meat eaters health is the main reason to eat less meat and they liked to vary their meals	Persuasion
De Magistris et al., 2015	The Netherlands, 153 consumers	Questionnaire; discrete choice experiment	Insect-based products	Random utility theory and Lancaster's consumer theory	What is the role of the European Novel Food Regulation on consumers' acceptance of and willingness to pay (WTP) for radical food innovations?	The visualization of insects on a product package might inhibit the success of insects as food	Confirmation

Table 2. Cont.

Author(s), Year of Publication	Country of Data Collection, Sample Size	Survey Design; Method	Type of Meat Substitute	Main Theory	Research Question	Main Conclusion	Category
Elzerman et al., 2011	The Netherlands, 93 consumers	Taste testing session; univariate and bivariate methods	Mycoprotein and soy	N/A	What is the influence of the meal context on the acceptance of meat substitutes?	During product development, more emphasis should be put on the meal context	Implementation
Elzerman et al., 2013	The Netherlands, 46 consumers	Focus group discussions and taste session; descriptive analysis	Generic, tofu and mycoprotein	N/A	What are consumers' experiences and sensory expectations of meat substitutes and the appropriateness of meat substitutes in meals?	Negative sensory aspects of meat substitutes were uniform taste, compactness, dryness and softness; most consumers found the use of meat substitutes appropriate in the dishes shown	Implementation
Elzerman et al., 2015	The Netherlands, 251 consumers	Questionnaire; univariate and bivariate methods	Generic	N/A	How do consumers rate appropriateness of meat substitutes in different dishes given visual information?	Appropriateness of meat substitutes in a dish is related to attractiveness and use-intention, thus meal context should be taken into consideration when developing new meat substitutes	Implementation
Hoek et al., 2004	The Netherlands, 4415 consumers (Vegetarians, n = 63, and consumers of meat substitutes, n = 39, meat eaters, n = 4313)	Questionnaire; logistic regression	Generic	N/A	How can meat eaters, vegetarians and meat substitute consumers be distinguished regarding socio-demographic characteristics, attitudes to food and health?	Strategies to promote meat substitutes for meat eaters should not only focus on health and ecological aspects of foods	Persuasion
Hoek et al., 2011a	UK and the Netherlands, 553 (non-users n = 324, light/medium-users n = 133, heavy-users of meat substitutes n = 96)	Questionnaire; regression	Generic	Usage segmentation, Stages of Change model	What is necessary to increase the consumption of meat substitutes?	The focus should not be on communication of ethical arguments, but the sensory quality and resemblance to meat of the meat substitute should be improved	Confirmation
Hoek et al., 2011b	The Netherlands, 34 consumers	Questionnaire; multi-dimensional scaling	Soy, vegetable, wheat, lentiles, pea, fungi	N/A	Which product category representations of meat substitutes have consumers in mind?	Innovative meat substitutes should have a resemblance to meat in order to replace meat	Implementation
Hoek et al., 2013	The Netherlands, 89 consumers	Questionnaire; regression	Tofu, mycoprotein	N/A	What can the long-term consumer acceptance of meat substitutes influence positively?	Liking of a meat substitute can be increased by repeated exposure for a segment of consumers	Implementation
McCarney, 1975	N/A	Qualitative interviews,	Synthetic meat	Theory of opinion leaders	How can synthetic meat be marketed?	Impediments to try meat substitutes were unfamiliarity, physical appearance, taste, nutritional value, availability of other substitutes like fish and the artificiality of the product	Persuasion

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Megido et al., 2016	Belgium, 79 students	Questionnaire and tasting session; univariate and bivariate methods	Insect- and lentil-based products	N/A	What is the level of sensory liking for hybrid insect-based burgers?	Insect tasting sessions can help to decrease food neophobia	Confirmation
Menozzi et al., 2017	Italy, 231 consumers	Questionnaire; Structural Equation Modelling	Insect-based products	Theory of Planned Behaviour	What is consumers' intention to and the behaviour of eating products containing insect flour in the next month?	Main barriers to consuming insect products are the sense of disgust, the incompatibility with local food culture and a lack of availability in the supermarket	Implementation
Mohamed et al., 2016	Malaysia, 500 consumers (among the Chinese community)	Questionnaire; factor analysis and binary logistics	Vegetarian food products	N/A	What are the dimensions of non-vegetarian consumers' opinions toward vegetarian food?	Influencing factors are environmental and animal well-being concerns, being taught to be vegetarian for religious reasons, and the influence of surrounding people on eating habits	Persuasion
Neo, 2014	Taiwan, 14 consumers	In-depth interviews; descriptive analysis	Generic	N/A	What are the challenges for an ethical consumption characterized by less meat consumption?	The various moral and nature-based framings of vegetarianism is weakened by the availability of a meat substitute	Persuasion
Pascucci and de-Magistris, 2013	The Netherlands, 122 consumers	Questionnaire; choice experiment	Insect-based products	Random utility theory and Lancaster's consumer theory	Is information affecting consumers' WTP for insect-based products?	While visualization negatively influenced consumers' WTP, information treatments do not mitigate this effect	Knowledge
Rimal et al., 2009	US and Canada, 3,000 households	Questionnaire; binary-choice model and a zero-inflated negative binomial model	tofu, vegetable burgers, soy milk, soy supplements, meat substitutes, and soy cheese	Lancaster's characteristics model and Fishbein's multi-attribute model	What are soy food consumption patterns?	Convenience of preparation and consumption and taste had strong effects on the consumption of soy products	Persuasion
Schösler et al., 2014	Netherlands, 1,083 consumers	Questionnaire, factor and cluster analysis	Generic	Self-Determination Theory	Can Self-Determination Theory help to foster more sustainable food choices?	Self-Determination Theory provided theoretical as well as policy-oriented insights into promoting more sustainable food choices	Persuasion

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Elzerman et al., 2011	The Netherlands, 93 consumers	Taste testing session; univariate and bivariate methods	Mycoprotein and soy	N/A	What is the influence of the meal context on the acceptance of meat substitutes?	During product development, more emphasis should be put on the meal context	Implementation
Tan et al., 2015	The Netherlands and Thailand, 54 consumers	Focus group interviews; coding	Insects and insect-based products	N/A	How does cultural exposure and individual experience contribute towards the evaluations of insects as food by consumers who have eaten and who have not eaten it yet?	Factors were identified that need to be taken into consideration when introducing insects to a culture where this food is not yet accepted	Confirmation
Van Honacker, 2013	Belgium, 221 participants	Questionnaire; factor and cluster analysis	Sustainable farmed fish, hybrid meat types, plant-based meat substitutes, insects	N/A	What are consumer opinions toward food choices with a lower ecological impact?	Consumers were rather reluctant to alternatives that (partly) ban or replace meat in the meal; opportunities of introducing insects (currently) appeared to be non-existent	Confirmation
Verbeke et al., 2015	Belgium, 180 participants	Questionnaire; univariate statistics	Cultured meat	N/A	Is cultured meat accepted by consumers?	A minority of consumers rejected the idea of cultured meat	Knowledge
Verbeke, 2015	Belgium, 368 participants	Questionnaire; binary logistic regression	Insects	N/A	Which consumer types are ready to adopt insects as a meat substitute?	The relevant consumers were characterised to be male, having a weak attachment to meat, were more open to trying novel foods and were interested in the environmental impact of their food choice	Confirmation

4. Results

Knowledge

The first stage in the innovation-decision process is knowledge. Consumers need to be informed about a novel meat substitute and may want to gather more information first. Papers were categorised if their research focused on how providing information influences consumers and three studies were identified. All carried out quantitative consumer research in Europe; two in Belgium and one in the Netherlands. In order to test the treatment of information, all studies had to compare the test and a control group statistically.

A more sustainable version of meat is cultured meat. In their study, Verbeke et al. [29] tested how information treatment influences willingness to try cultured meat. Thirteen per cent of respondents in Belgium had heard about cultured meat. Basic information about its technology had less influence on the willingness to try cultured meat than additional information about benefits. However, scientific results on whether information influences WTP are ambiguous (Verbeke et al. [29]: higher WTP; Pascucci and de-Magistris [30]: no influence). Providing information and the right kind of information can influence consumers' acceptance of insect food. Barsics et al. [31] demonstrated this by giving information about entomophagy to a test sample before test-tasting bread that was labelled as containing insects (although it did not contain insects).

A limitation of comparability for these three studies is that while two studies are hypothetical online studies, Barsics et al. used a non-hypothetical setting [31].

Persuasion

The persuasion stage is characterised by consumers' evaluation of the available information. Here, consumers collect information actively, evaluate arguments and convince themselves of the meat substitute's value or otherwise. Nine papers were identified; seven include quantitative consumer research and two papers provide in-depth interviews. Hypothetical surveys and qualitative interviews were the focus at this stage. The research was carried out in the UK ($n = 2$), Italy ($n = 1$), the Netherlands ($n = 3$), the US as well as in Malaysia ($n = 1$) and Taiwan ($n = 1$).

As early as 1975 McCarney [32] analysed via qualitative interviews impediments to the introduction of synthetic meat. At the time, impediments were unfamiliarity, physical appearance, taste, nutritional value, availability of other substitutes like fish and the artificiality of the product. Today, the perception of taste and the appearance of the meat substitute is still one of the most important impediments, regardless of country of residence [33–37]. Habits are another strong barrier [34,35] Personal characteristics such as sociodemographic variables, food lifestyle and attitudes towards a vegetarian diet [34,35,38] as well as enjoying cooking and eating were also essential factors in terms of persuasion (Schösler et al., 2014) [39]. Further drivers for persuasion to consume meat substitutes are animal welfare concerns, environmental impact of meat production and sustainability aspects in general as well as health aspects [34–36,40]. Here again, there were no strong differences between consumers in the different countries studied.

Decision

The third stage in the innovation-decision process is the decision to try or decline a meat substitute food. Drivers on why consumers buy or do not buy or rather try a meat substitute were analysed. Seven studies containing quantitative consumer research were included. Choice experiments as well as tastings and cluster analyses were the applied methodologies in this stage. Research is focused on insects and in the Netherlands ($n = 3$), UK ($n = 1$) and Belgium ($n = 3$) and for cross-cultural comparison also in Thailand ($n = 1$).

Consumer studies on meat substitutes show that environmental arguments are no longer critical in the decision stage [15,41,42] Consumers decide in terms of appearance and sensory aspects rather than on the analogy of meat [15].

However, in Belgium there are also consumer clusters that are reluctant to decide in favour of insects and meat substitutes in general [17,43]. The consumer profile most likely to be an early

adopter is a young male with no strong meat consumption habits, who is not neophobic and has environmental food-purchasing motives [43]. To reduce food neophobia, repeated tasting of insects is necessary [42,44]. For a transition phase, masking the insect aspect and not visualising them on the package might increase consumption in Europe [44,45]. For Thai consumers, insects are already common food and thus food neophobia is not particularly pronounced with regard to insects [42].

Implementation

The implementation stage is particularly important as the success of any meat substitute depends on whether the product will be bought regularly. For the implementation stage, eight papers could be identified; seven contain quantitative research and one includes focus group discussions. Methodologies applied in this stage were (web-based) questionnaires, tastings and in-home product tests. Six studies were carried out in the Netherlands, one in Italy, and one in South Africa. Analysed products were insects, soy-based products, mycoproteins as well as meat substitutes resembling meat in appearance and taste.

In Italy as well as in the Netherlands, health and environmental impacts have an influence on the implementation of meat substitutes in the daily context [46–48]. For the implementation in everyday life—in contrast to a more experimental setting—consumers put more emphasis on the meat substitute in the context of the meal than on individual meat substitutes' flavour or texture in more experimental settings [14,16]. Meat substitutes should resemble meat or common meal structures such as spaghetti, rice and wraps in order to replace meat in meals and thus encourage meat substitute implementation [16,46,49]. Barriers for implementation are lack of availability, incompatibility with local food, high prices and insufficient information on the food package as well as uniform taste, compactness, dryness and softness [46,47].

No cross-cultural comparisons can be made for the EU. However, Bosman et al. [50] found cultural differences for consumer groups in South Africa between Blacks, Indians and Whites. Marketing needs to be adjusted for each ethnic target group.

Liking of meat substitutes can be increased by repeated consumption. While initial liking or disliking is decisive, follow-on exposure can increase the probability of implementing a meat substitute in the diet [40].

Confirmation

For the confirmation stage of the innovation-decision process, no studies could be identified.

5. Discussion and Suggestions for Future Research

Knowledge

The results show that providing information on the benefits of meat substitutes can influence consumer adoption. The number of publications is low. Product packaging tests (split sampling design) have not been carried out, although they could reveal what information holds most promising for marketing meat substitutes. This might be an appropriate approach for future research. However, it might also be the case that such studies could not be identified as they are of interest for product marketers. Most probably those studies already exist in the private sector. Thus, a collaboration of the public and private sector might be a strategy to carry out most powerful research. Furthermore, and as a first step, more research is needed on how consumers find out about meat substitutes in the first place.

Persuasion

In order to persuade consumers, perception of taste and the appearance of meat substitutes are essential. Perception is therefore a critical factor if consumers are to develop a positive attitude towards a novel meat substitute. Positive persuasion drivers involve arguments on health, environment as well as animal welfare aspects. Research reveals that personal characteristics, food lifestyle and attitudes

towards vegetarian meals cannot be changed easily and there are consumer segments which are not open to meat substitutes. As a result, marketing for target groups has to be developed by carrying out latent class analyses in a first approach, see e.g., Apostolidis and McLeay [40].

This definition of potential target groups for meat alternatives is therefore essential to adapt marketing strategies. However, the data analysed by Hoek et al. [38] are from 1997/1998. The characteristics of food lifestyles might have changed today. A replication of this study together with cross-cultural comparisons in Europe would deliver interesting results for companies and policymakers promoting a less meat-based diet.

Cultured meat has not been the focus of recent studies and other special meat substitute ingredients like lucerne or algae have not been researched at all. More fundamental research such as sensory analyses is needed to confirm whether these alternatives to conventional meat could persuade consumers and, consequently, accelerate product development of these alternatives. More promising consumer research results could also attract commercial investment in technologies needed for alternatives to conventional meat products.

Decision

When it comes to the decision for or against a meat substitute, environmental arguments are no longer decisive. Research suggests that repeated consumption of meat substitutes is necessary to form a favourable attitude. However, returning to the persuasion stage, pleasant taste is the main requirement for repeated consumption. More studies in different countries should be carried out combining information treatment, purchase motivations and the calculation of WTP for meat. Control and test groups should be included. Marketing strategies for the product launch could then be effectively tested.

A lot of insect-based food research can be found in the Netherlands. Studies in other countries and on different meat substitutes are relevant as well, especially in regard to target groups in terms of product development: are there cultural differences or could the same products be appropriate for different European countries?

Implementation

For the implementation of meat substitutes on a regular basis, environmental and health aspects might be more important than in the decision stage. Decisive factors seem to be appearance and taste, but also involve availability and compatibility with local food. A question that arises is whether the aim of meat alternatives is to substitute meat in meals (as the name suggests) or are consumers not necessarily looking for a substitute for meat but rather for an alternative that does not have to be meat-like? There is hardly any research on that particular question, although it is an essential aspect for implementing meat substitutes for regular consumption.

Again, most studies on meat substitutes have been carried out in the Netherlands and should also be conducted in other (European) countries as also suggested by Weinrich [51].

Confirmation

No studies could be identified for the confirmation stage. This might be due to the fact that in order to analyse whether consumers have revised their decision for or against meat substitutes, a long-term follow-up study would be necessary. Long-term studies have the difficulty that many participants are not available after, for example, one year, never mind after five or ten years. Achieving a quantitatively suitable sample is therefore a challenge. However, such research might be the key to understanding why meat substitutes have not become established over the long term. It must therefore be worth the effort for research to be carried out on this stage.

6. Conclusions

Consumption patterns with high meat rates are far from being sustainable [13]. Thus, a more sustainable diet should include less meat consumption, e.g., by replacing meat by meat substitutes.

Taste and appearance and also the perception of taste and appearance are the most crucial factors for the successful adoption of meat substitutes by consumers. Easy availability and compatibility with local food are essential for long-term success. The focus of research is on soy and insects. Much more needs to be known about meat alternatives such as algae, lupines, quinoa, peas and other protein sources. Furthermore, no cross-cultural comparisons are available and are therefore important issues for future research.

There is also a lack of research on why consumers revise their adoption of novel food. More surveys could help to explain high failure rates for meat substitutes. Only if we learn more about consumers' long-term decisions will it be possible to reduce meat consumption and increase the adoption of meat substitutes in order to achieve healthier plant-based, more sustainable eating patterns. It is also very surprising that no paper discusses whether one barrier to establishing meat substitutes is consumers' fixed idea, that they might face protein deficiency if they substitute meat. Further, this is also a very crucial point for producers and retailers, as they want their products to be established on the food market and to gain high rates of repurchases. Future research should also tackle this barrier.

Most research on meat substitutes has been carried out in the Netherlands. This is not surprising considering the country's population density combined with a lot of innovation in the Dutch food sector and the country's general openness to innovation [52]. However, it is important for all industrialised societies as well as for developing countries to face up to health problems involved with high meat consumption as well as the increasing demand for meat worldwide. That in turn leads to the environmental problems that this demand creates, plus the ongoing animal welfare discussion in many western countries and then the search for alternative plant-based meat substitutes. Finally, Roger's model of the innovation-decision process applied to analysing why meat substitutes have not been established on the food market revealed that in the confirmation stage, no research has been carried out. In particular, research at this stage of the process might be crucial to understand why promising meat substitutes have not to date been successful in the long run. This result leads to the conclusion that in future research there should be a strong focus on the evaluation as to why consumers do not establish meat substitutes in their diets on a regular basis? Rogers' model should be extended in a new approach in a way that the motivation, why consumers decide to try meat substitutes or not, is integrated. Further, research about target groups should also come into focus to learn more about size and motivation of the target group(s). Additionally, Rogers' model had the limitation that the papers were partly hard to put into one category. Thus, in future research, the model should also be adapted in a way that the categories are less selective.

Furthermore, the results are also interesting for policy makers. First, the review reveals that there is focus of research in the Netherlands. This is also a country where meat substitutes are already a part of the diet of many consumers. The question must remain open, how this correlation can be explained. Policy makers in other (European) countries should promote research to find out more about motivation and barriers to consume meat substitutes in other countries as well. Second, policy makers can use scientific results to develop strategies that reduce meat consumption or rather increase consumption of meat substitutes, e.g., nudging or marketing campaigns or by supporting start-ups developing and selling meat substitutes. More precisely, as research shows that providing information about meat substitutes can influence acceptance, a large-scale marketing campaign could inform consumers about the availability and the benefits, e.g., health benefits of eating less meat, to promote the consumption of meat substitutes. Another possibility would be to offer meat substitutes in canteens and cafeterias on a regular basis as the research shows that habits are a strong barrier to implement meat substitutes. The meat substitutes can be specially advertised and offered at introductory prices for a longer period of time, e.g., one year.

Conclusively it can be said that meat substitutes are still far from being established on a large scale, but there are many possibilities to promote the consumption, be it at the research, corporate or political level.

Funding: The publication was funded by the Lower Saxony Vorab by the Ministry of Science and Culture (MWK).

Acknowledgments: I gratefully thank Jana Rose for her support in scanning the databases and data preparation.

Conflicts of Interest: The author declares no conflict of interest.

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