

Article

Perceptions of Vegan Food among Organic Food Consumers Following Different Diets

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Abstract: This article identifies consumer segments for vegan food by analysing perceptions of vegan food among food organic consumers following different diets: vegans, vegetarians, former vegetarians, flexitarians, and omnivores. The analysis is based on responses to a quantitative consumer survey for which 503 participants were recruited from customers at German grocery stores by quota sampling according to diet and region. From the responses to an open-ended question eliciting the participants' associations with vegan food, the analysis finds that vegans and vegetarians perceive vegan foods primarily as being beneficial for animal welfare, healthy, and environmentally friendly, while those who ate meat perceive vegan food primarily as containing no animal ingredients and as being healthy. The respondents' varying assessments of the taste, diversity, and environmental benefits of vegan food were found to differ in relation to the various diets they followed, as did their assessments of how long the vegan trend is likely to last. A cluster analysis based on the consumers' perceptions and attitudes revealed three consumer groups: "vegan fans", "enjoyment sceptics", and "originality-sceptics". Scepticism about the originality of vegan food was found in all diet groups. These findings can help inform more effective targeting of consumer needs for vegan organic food.



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Keywords: vegan; vegetarian; plant-based; consumer segments; organic food; consumer attitudes; motives

1. Introduction

A vegan diet is particularly sustainable and is considered as an effective way to reduce diet-related greenhouse gas emissions [1–6]. The most environmentally friendly diet is the vegan diet based on organic food [7] and multiple studies have shown that consumers who have a strong preference for organic food tend to consume less meat or animal products than other consumers [8–13] and more vegetables and fruits [14]. Thus, organic food consumers are an interesting target group to increase the consumption of vegan food and to promote a shift towards more sustainable diets. It is therefore worthwhile to analyse how organic food consumers perceive vegan food in order to be able to address these consumers as a target group for vegan food and consequently increase the sales of vegan food. Moreover, the size of the group of organic food consumers is quite large—in Germany, organic food is currently bought at least occasionally by 80% of consumers [15] (p. 9).

The overall objective of the study was to explore the perception of organic food consumers towards vegan food. The aim is to analyse consumers' associations and attitudes towards vegan food by defining different consumer group profiles. Given the very different diet styles followed by contemporary consumers [16–21] a special focus is set on a differentiation of consumers according to their diet preferences. Furthermore, the explorative segmentation process is based on the perceptions and attitudes of consumers regarding vegan food. The findings of the study can be used to improve the development of vegan products and better tailor them to consumer needs as well as for improving communication measures about vegan food products.

The paper is organized as follows: Section 2 reviews the literature both on consumers' motives for following vegan, vegetarian, and meat-reduced diets and on the perceptions and attitudes of consumers regarding vegan food; Section 3 introduces the methods of data collection and analysis; Section 4 presents the results of the empirical investigation; and Section 5 discusses the main results, identifies some limitations of the study, and draws conclusions for marketers of vegan food.

2. Literature Review

2.1. Consumer Attitudes to Vegan Food

Previous studies have focused on consumer attitudes to vegan foods in general as well as more particularly on attitudes to meat substitutes and foods with plant protein. According to a literature review by He et al. [22], the basic acceptance of plant-based meat alternatives has increased slightly in recent years but still remains low. Taste has been identified in several review articles as a critical factor for the acceptance of vegan meat alternatives and a plant-based diet [23–25].

Consumers who attach more importance to health and naturalness when shopping for groceries also tend to eat plant-based dishes more often [26]. Abstaining from meat and consuming meat substitutes are both generally considered to be healthy practices. However, meat substitutes are also perceived as unhealthy by some consumers due in part to the assumption that meat avoidance leads to malnutrition [27,28]. Soya milk has also been found to be considered unnatural and unhealthy than cow milk [29]. A study by Miguel et al. [30] has confirmed that ethical motives, specifically attitudes towards environmental protection and animal welfare, have a significant effect on attitudes towards vegan food and consequently influence consumers' involvement with vegan food, their purchase intentions for vegan food and the likelihood of their recommending vegan food to other consumers by word of mouth. Overall, a plant-based diet is perceived as environmentally friendly and environmental concern increases consumers' purchase intention for plant-based meat substitutes and vegan products [31–34]. Weinrich [24] concludes that the health and environmental benefits of meat substitutes are important for attracting the attention of consumers to these products, although whether such substitutes will be consumed more frequently depends primarily on how they taste. Consumers perceive vegan food and meat substitutes as expensive and studies have identified expensiveness as a major barrier to the purchase of plant-based products [27,35–38].

2.2. Diet Styles and Motivations to Abstain from Animal-Based Food

With regard to the consumption of animal-based food, a distinction can be made between different diets: According to the International Vegetarian Union, vegetarians follow “a diet of foods derived from plants, with or without [emphasis in original] dairy products, eggs and/or honey” whereas vegans “exclude “any use of any animal products for any purpose” [39]. “A person who follows a primarily but not strictly vegetarian diet” is called flexitarian [40]. Despite the increasing prevalence of flexitarian diets, there is no generally accepted definition of the degree of meat reduction required to be classified as a flexitarian, and the definitions of flexitarianism used in scientific studies vary in detail [41].

People's motivations for abstaining from meat and following a vegetarian diet have been investigated in numerous studies. Reviews of these studies by Ruby [42] and Rosenfeld [43] have shown that concerns about animal welfare, health benefits, and environmental protection are consistently found to be key motivations for a vegetarian diet. The majority of these studies have identified animal welfare as the primary motive for a large proportion of vegetarians and vegans, while a smaller number of studies have found health to be the most prevalent motivation.

Regarding the main motives, no differences can be found between a vegetarian diet in general and a stricter vegan diet. Studies that have explicitly examined motives for adopting a vegan diet have identified three major motivations for choosing a vegan diet: firstly, ethical concerns, especially concerns about animal welfare [44–52]; secondly, health

reasons [46–53]; and thirdly, somewhat less important, concerns about the environment and climate change [44–47,51,53,54].

Some of the reviewed studies identified other motives for adopting a vegan diet, including taste-related factors [48,52] religious beliefs and practices [44,53], global/humanitarian reasons [48], and the influence of individuals' social and family environments [44,48,53].

People's decision to follow a vegetarian diet is not necessarily a permanent decision. Many people resume meat consumption after a period of vegetarianism, often for health reasons such as concerns about malnutrition [16,55,56]. Factors in one's personal social environment have also been found to have an important influence on people's decision to return to eating meat [16,56,57].

The reasons for reducing the consumption of meat, i.e., for following a "flexitarian" diet, are found to be similar to the reasons for abstaining from meat altogether. However, ethics related to animals are less important for flexitarians than for vegetarians [17,58,59]. A study by Izmirlı and Phillips [60] has identified concerns for environmental protection as the most important motive for adopting a flexitarian diet, although several other studies have found that environmental protection is generally considered less important by flexitarians than vegetarians [17,20,51,61–63]. Health reasons are often identified as a particularly important motive for adopting a flexitarian diet [17,18,20,51,63,64].

On the basis of these reviewed findings on the factors involved in people's renunciation of animal products, the following five diet-related consumer groups seem to be of particular importance for the study of vegan food consumption: vegans, vegetarians, former vegetarians, flexitarians, and omnivores. Vegans and vegetarians together are estimated to comprise between 3% and 10% of the German population [65], [66] (p. 81), [67] (p. 81), [68], with vegans constituting 0.3% to 1.6% of the total population [65] (p. 12), [66] (p. 81), [67] (p. 81), [68] (p. 252). Data on the prevalence of flexitarian diets in Germany vary greatly due to the lack of a generally accepted definition of the term "flexitarian", with estimates ranging from 12% to as much as 55% of the population [65] (p. 12), [69] (p. 59). In the current paper, flexitarians are defined as persons who either consciously abstain from meat at times or eat meat only rarely, while "former vegetarians" refers to those respondents who had followed a vegetarian diet for at least half a year in the past before resuming meat-eating, regardless of whether they now ate meat frequently or selectively. There are no current figures on the prevalence of former vegetarians in the population of Germany.

3. Materials and Methods

3.1. Data Collection

The target group of this study were consumers in Germany who buy organic food. Accordingly, only those consumers who answered "yes" to the screening question "Do you buy organic food several times a year?" were invited to participate in the interview. Further screening questions clarified which of the five diets each person followed, i.e., vegan, vegetarian, former vegetarian, flexitarian, or omnivore. For each of these different diets, the number of participants selected was determined by predefined quotas. As vegans are a particularly important but relatively small and also rarely researched target group for vegan food, a non-proportional quota sampling strategy was used. More vegans were interviewed to compensate the uncertainties resulting from the lack of knowledge about this rare dietary habit. Specifically, it was planned to interview 150 vegans and 75 people from each of the groups following non-vegan diets. To ensure an adequate geographical distribution of interviews, quotas were also specified for the number of participants from the north, south and east of Germany.

For recruiting the survey participants, face-to-face interviews were conducted in organic food shops, vegan food shops, and general food shops. To minimize social-desirability bias, the interviews for the study were carried out by the participants on laptops in the shops in the form of a computer-assisted self-administered survey. A total of 503 customers were surveyed, of whom 152 were vegans.

A market research institute was contracted to select the shops, recruit the participants, and conduct the self-administered surveys in the shops. To ensure high data quality and prevent interviewer fraud, the interviewers were checked by university staff.

The questionnaire contained questions about sociodemographic characteristic (age, gender), meat consumption frequency (translated question wording: “How often do you usually eat meat and/or sausages”; answer options: (a) daily, (b) four to six days per week, (c) on one to three days per week, (d) less than once a week, but several times a month, (e) at most once a month, but several times a year, (f) once a year or less; question was only presented to meat-eating respondents), the duration of the current diet (translated question wording: “For how many years have you been following a vegan diet?” for vegans and “For how many years have you been following a vegetarian diet?” for vegetarians) and questions about respondents’ attitudes to vegan food. The participants were first asked to respond to an open-ended question in order to elicit their associations with vegan food (translated question wording: “What do you associate with vegan food? Please name up to three characteristics or terms that come to your mind spontaneously”). A seven-point semantic differential scale with eight bipolar pairs was then used to underpin the answers given to the initial open-ended question. The participants were further asked to indicate their responses to a series of statements on a seven-point Likert scale (translated question wording: “Please indicate which characteristics apply to processed vegan food in your view. Answer spontaneously and don’t take too much time to think about”). These statements were randomised to prevent any order effect. To clarify the use of the term “vegan food” in the survey, it was pointed out to participants that this term referred here to processed food and not to fruit and vegetables. The final questionnaire was pretested with individuals of a convenience sample.

3.2. Data Analysis

All Analysis of the responses to the open-ended question about associations with vegan food was undertaken in three steps. Two researchers first individually and separately developed categories for the survey responses, inductively deriving a system of categories from the answers given. These categories were then synthesized to produce a unified category system of 19 categories. In a second step, two researchers separately categorised all answers according to the developed category system. The researchers’ categorisations were found to be mutually consistent for 90% of the categorised terms. In a third step, all terms that were not classified in the same category were discussed by the researchers to select the most suitable categories for each term. This consensual coding safeguarded the reliability of the coding process and ensured all terms were assigned to an appropriate category [70] (p. 74).

The analysis was differentiated according to the five consumer groups following different diets. A one-way analysis of variance (ANOVA) was used for interval-scaled variables to test differences among means. For multiple comparisons between the five groups, a post-hoc test with Bonferroni correction was used [71] (p. 447). Where the assumption of homogeneity of variances was violated (Levene-test, $p < 0.05$), the Welch-test and a Games–Howell post hoc test were applied.

For further data analysis, a principal component analysis (PCA) based on the results of the semantic differential was conducted to reduce the number of variables for the cluster analysis. A sufficient correlation of variables is a prerequisite for performing PCA. This requirement was tested by Bartlett’s test of sphericity and by examining the measure of sampling adequacy (MSA) values for each variable and the MSA values overall [72] (p. 104). To ensure that the variance of the variables was sufficiently represented by the factors, variables with communalities below 0.5 were deleted [72] (p. 119). To determine the number of factors, a parallel analysis was conducted according to Horn’s [73] method. To facilitate factor interpretation, an orthogonal factor rotation was performed using the VARIMAX method [72] (p. 115).

The next step in the data analysis was a cluster analysis based on the factors derived from the PCA. To identify outliers, the agglomerative next neighbour hierarchical technique (single linkage method) was applied (based on Euclidean distance). Different clustering techniques were used to determine the appropriate number of clusters in order to balance the advantages and disadvantages of each method [74] (p. 77). A further hierarchical cluster analysis was conducted using Ward's clustering method (also based on Euclidean distance) and the partitioning clustering method "k-means" was applied. The k-means cluster analysis was calculated for different numbers of clusters in the range of two to seven and the results were compared with each other on the basis of the within-sum-of-squares values. The optimal number of clusters was determined using the elbow method [75] (pp. 42–44) and on the basis of the average silhouette width [76] (p. 129). In addition, the k-means analysis was run 2000 times with random starting points in order to avoid any bias arising from the predefined initial values.

4. Results

4.1. Socio-Demographics

The socio-demographic characteristics of the sample are summarised in Table 1 according to the different diets of the participants. Women comprised the majority of participants in all diet groups except for the omnivores group in which there were an equal number of female and male participants. Regarding the age of the respondents, the proportion of vegan consumers below 40 years old was particularly high (60%), while only 5% of the vegan consumers were 60 years old and over, in contrast to the German population as a whole in which these shares are 27% and 28%, respectively. The average age of vegans, 37.7 years, was consequently somewhat lower than the average age of persons following other diets (41.4 years to 47.9 years).

Table 1. Socio-demographic characteristics of the sample.

	Vegans	Vegetarians	Former Vegetarians	Flexitarians	Omnivores	German Population
N	152	96	91	89	75	
Gender: Proportion of women	64%	78%	71% ¹	60% ²	50% ³	51% ⁴
Age in years [Mean (SD)]	37.7 (12.2)	41.4 (14.1)	47.9 (13.2)	43.4 (15.6)	43.5 (14.9)	44.3 ⁵
Aged 18 to under 40 years	60%	52%	43%	34%	44%	32% ^{5,6}
Aged 40 to under 60 years	36%	34%	42%	38%	41%	35% ^{5,6}
Aged 60 years and over	5%	14%	15%	28%	15%	33% ^{5,6}

SD = standard deviation; ^{1–3} Due to missing values for the variable gender, the number of responses deviates: ¹ N = 89; ² N = 87; ³ N = 74.

⁴ Source: [77]. ⁵ Source: [78] (pp. 11–12). ⁶ German Population 18 years and older.

4.2. Frequency of Meat Consumption

At the beginning of the survey, the meat-eating participants were asked how often they consumed meat (Table 2). The most frequent consumers of meat were the omnivore group, only 1% of whom ate meat less than once a week and 23% ate meat every day. The second most frequent eaters of meat were the flexitarians, i.e., those participants who had stated in the screening interview that they consciously abstained from meat at times or 'only rarely' ate meat. Of the flexitarians, 22% of ate meat less than once a week, but several times a month, and a further 6% ate meat at most once a month, but several times a year. The former vegetarian participants consumed meat considerably less frequently than the flexitarians, with only 7% of this group consuming meat on four days per week or more. A Kruskal–Wallis test revealed that there was a significant difference in the frequency of meat consumption between vegetarians, flexitarians and omnivores (Kruskal–Wallis test $H(2) = 100,381, p < 0.001$).

Table 2. Frequency of meat consumption.

	Former Vegetarians	Flexitarians	Omnivores
N	91	89	75
Daily	0%	3%	23%
Four to six days per week	7%	15%	45%
On one to three days per week	36%	54%	31%
Less than once a week, but several times a month	30%	22%	1%
At most once a month, but several times a year	22%	6%	0%
Once a year or less	5%	0%	0%

4.3. Duration of Vegan and Vegetarian Diets

The survey asked the vegan and vegetarian respondents to indicate how long they had been following their respective diets. Of the vegans, 12% had followed this diet for more than ten years, although 80% had followed a vegetarian diet prior to switching to a vegan diet. The average duration of following a vegan diet was 5.9 years, with the median duration being five years. If the period of their vegetarian diet prior to adopting a vegan diet is also taken into consideration, however, the proportion of vegans who had followed vegan or vegetarian diets for more than ten years was 47%. On average, the vegans had followed a vegan or vegetarian diet for 12.6 years, with a median duration of nine years.

Quite similar results were found for vegetarians, who on average had been following their diet for 13.5 years, while the median duration of being vegetarian was ten years. Some 47% of the vegetarian respondents had abstained from meat for more than ten years.

4.4. Associations with Vegan Food

Table 3 presents the participants' responses to the open question about their associations with vegan food according to the five different diet groups. The fact that vegan food is free of any animal ingredients was reflected in many answers to this question. The responses of the vegan and vegetarian groups expressed this aspect more often through associations which are summarised in the category "aspects of animal husbandry". This category includes associations with animal welfare and animal husbandry, i.e., statements that vegan foods could render animal husbandry redundant and end animal suffering, with some responses citing specific aspects of animal husbandry to which they objected. Thus, 39% of the vegans (most frequent association of vegans) and 24% of vegetarians mentioned associations that fell into this category. By contrast, the groups of respondents who at least occasionally ate meat made fewer associations of vegan food with animal husbandry in their responses to this question (18% of flexitarians, 6% of former vegetarians, and 4% of omnivores), more often simply mentioning the fact that vegan food has no animal ingredients (31% of flexitarians, 35% of former vegetarians, and 37% of omnivores).

Terms like "healthy" and "health" were frequently associated with vegan food in the respondents' answers, including specific descriptions of such food as being "low-fat" and "rich in vitamins", etc. Health aspects were associated with vegan products not only by vegetarians (40%) and vegans (34%), moreover, but also by the meat-eating participants (associated by 26% of flexitarians, 23% of former vegetarians, and 25% of omnivores). On the other hand, some consumers perceived vegan food as "unhealthy" or "rich in fat", with some using terms like "malnutrition" in association with vegan products (mentioned by 6% of vegans, 4% of vegetarians, 7% of flexitarians, 12% of former vegetarians and 15% of omnivores).

Table 3. Associations with vegan food.

Vegans N = 150		Vegetarians N = 96		Former Vegetarians N = 89		Flexitarians N = 84		Omnivores N = 71	
aspects of animal husbandry	39%	healthy	40%	other	33%	without animal ingredients	35%	without animal ingredients	37%
healthy	34%	aspects of animal husbandry	24%	without animal ingredients	31%	healthy	23%	healthy	25%
environmentally friendly	25%	environmentally friendly	22%	healthy	26%	vegan products	17%	other negative associations	21%
other positive associations	22%	without animal ingredients	20%	aspects of animal husbandry	18%	little or no taste	13%	unhealthy	15%
good taste	18%	vegan products	15%	vegan products	16%	other negative associations	12%	vegan products	14%
without animal ingredients	13%	organic food	14%	other negative associations	16%	artificial	12%	expensive	13%
social responsibility	12%	artificial	11%	environmentally friendly	15%	unhealthy	12%	organic food	13%
vegan products	11%	good taste	11%	artificial	11%	expensive	10%	fashion	11%
organic food	9%	fashion	11%	fashion	10%	fashion	8%	natural	8%
ethic	9%	other positive associations	10%	little or no taste	9%	environmentally friendly	8%	artificial	6%
expensive	7%	expensive	10%	other positive associations	8%	aspects of animal husbandry	6%	little or no taste	6%
natural	6%	ethics	7%	good taste	8%	other positive associations	5%	environmentally friendly	6%
unhealthy	6%			organic food	7%	organic food	5%		
				unhealthy	7%				
				expensive	6%				

The table shows mentions that were expressed by at least 5% of the respondents. Multiple answers possible. Associations that belong together in terms of subject matter are highlighted in the same colour.

One out of four vegans, 22% of the vegetarians and 15% of the former vegetarians associated vegan food with environmental friendliness or sustainability. Omnivores (6%) and flexitarians (8%) mentioned these associations far less frequently. That vegan products are “organic food” was mainly mentioned by vegetarians (14%) and omnivores (13%). Several participants associated vegan food with the attribute “expensive”, irrespective of their different diets (6% of former vegetarians to 13% of omnivores). Some of the respondents saw vegan food as a passing fashion or trend, although this appraisal was hardly ever stated by vegans themselves.

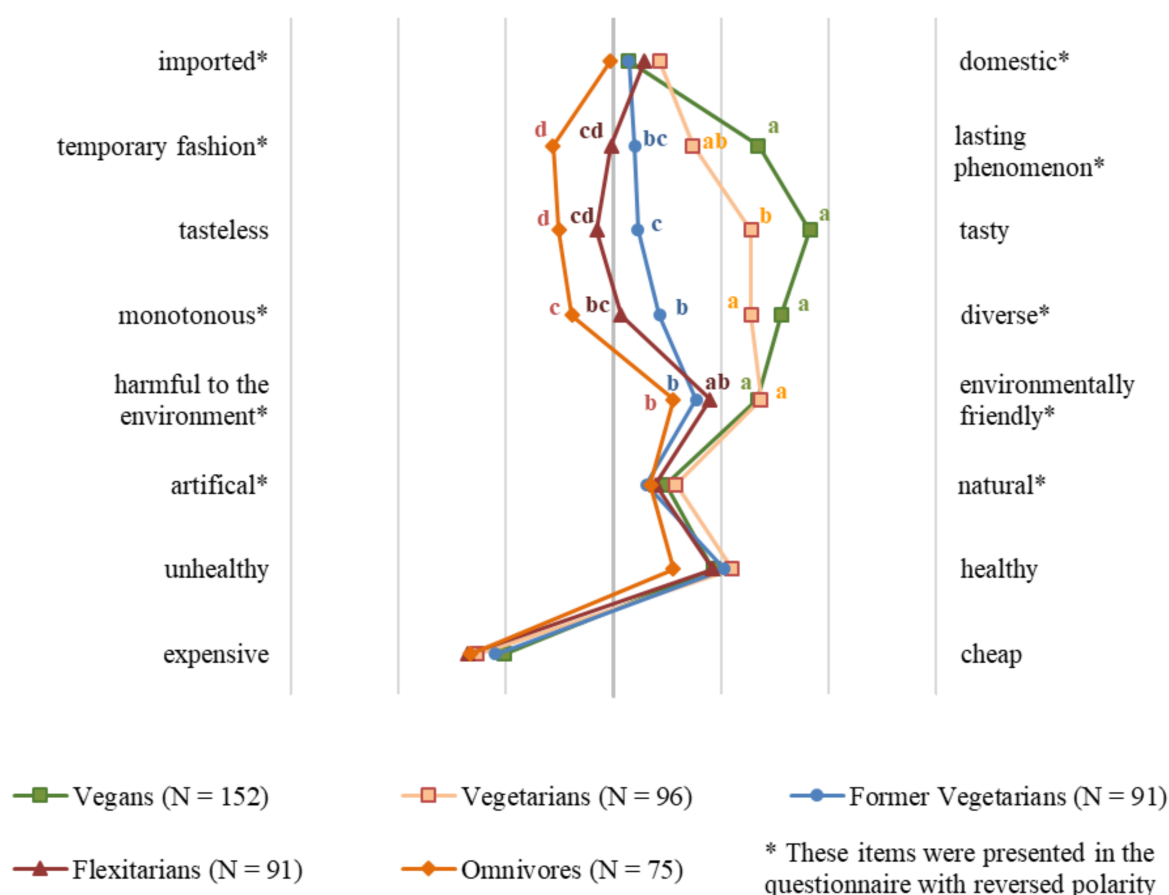
Of the vegans, 18% associated vegan food with having a good taste. As expected, vegans mentioned this association more often than any other group (2% of flexitarians to 11% of vegetarians). Indeed, no vegans criticized the taste of vegan food, while such criticisms were stated by participants in all other groups (3% of vegetarians to 13% of flexitarians). Among those who ate meat at least occasionally (former vegetarians, flexitarians, and omnivores), the taste of vegan food was criticized more often than it was praised.

While vegan food was seen as “natural” by some participants, primarily by vegans (6%) and omnivores (8%), other respondents associated such food with being “artificial” (3% of vegans to 12% of flexitarians). Included in this category were not only responses that directly associated vegan products with being “artificial” but also those that described vegan food as “industrially processed” or that mentioned keywords such as “additives” or “chemicals”.

4.5. Consumers' Attitudes towards Vegan Food

The answers to the open-ended question were confirmed by querying the participants' attitudes towards vegan food using a semantic differential.

No significant differences were detected in the responses of the participants from different dietary groups in their evaluation of the origins of vegan food between the poles "imported" and "domestic" (Welch's $F(4, 223.05) = 1.288$, $p = 0.300$). Nor was any clear tendency discernible, with all average values of the groups being in the centre (Figure 1).



a,b,c,d Different letters indicate significant differences between means ($p \leq 0.05$).

7-point scale, presented between the opposing terms. Gradations were not further described.

Figure 1. Perceptions of vegan food among people following different diets.

Vegan food was considered to be a lasting phenomenon rather than a passing trend by vegans more often than by those participants who ate meat from time to time, i.e., former vegetarians (mean = 4.20), flexitarians (mean = 3.98), and omnivores (mean = 3.44), $F(4, 498) = 19.586$, $p < 0.001$).

Regarding the participants' evaluation of the taste of vegan food, the vegan group differed significantly from those following other diets in positively appraising the taste of such food (Welch's $F(4, 219.79) = 51.406$, $p < 0.001$). Vegetarians (mean = 5.28) were more critical than vegans (mean = 5.83) of the taste of vegan food, although they rated it significantly more positively than those participants who ate meat from time to time (former vegetarians (mean = 4.23), flexitarians (mean = 3.84), and omnivores (mean = 3.49)). The most negative appraisals of the taste of vegan food were given by the omnivores, whose ratings were not only significantly more negative than those of vegans and vegetarians but also those of former vegetarians.

The participants' evaluations of the "diversity" of vegan food were similar to their evaluations of taste and differed statistically significant between the different diets ($F(4, 498) = 29.085, p < 0.001$). Only vegans assessed the diversity of vegan products as slightly worse than previously the taste. Thus, no significant difference could be detected between vegans (mean = 5.56) and vegetarians (mean = 5.28) regarding their evaluation of the diversity of vegan products.

Overall, the respondents tended to appraise vegan food as environmentally friendly, although there were significant differences in the appraisals of the various diet groups (Welch's $F(4, 224.19) = 5.406, p < 0.001$), with vegans (mean = 5.34) and vegetarians (mean = 5.38) seeing vegan food as more environmentally friendly than omnivores and former vegetarians (mean = 4.77).

The participants' evaluations of whether vegan food is "artificial" or "natural" revealed no differences between the diet groups (Welch's $F(4, 223.21) = 0.397, p = 0.811$). Across the groups, a slight tendency towards "natural" could be observed. Vegan food was rated as "healthy" ($F(4, 498) = 1.499, p = 0.201$) and was perceived as "expensive" ($F(4, 498) = 1.478, p = 0.208$) by all of the dietary groups.

A PCA was carried out with all eight items from the semantic differential. The item regarding price perception (expensive vs. cheap) was excluded, however, since the communality of the variable was less than 0.5. After the exclusion of this variable, the conditions for the PCA were tested again and were all fulfilled (Bartlett's test of sphericity ($X^2(21) = 1.166, 10, p < 0.001$, overall MSA value 0.82, lowest MSA value of a single variable 0.73). The parallel analysis showed that the extraction of two factors was the most appropriate solution. This result was further confirmed by other common criteria for determining the number of factors, such as the Kaiser–Guttman criterion and the Scree test. Each variable loaded only to one of the two factors. Factor 1 implies the perception of vegan food as "original" food, which includes the perception of vegan food as natural, environmentally friendly, healthy, and local in origin. The second factor is named "enjoyment", which includes perceptions of vegan food as tasty, diverse and as a long-term phenomenon. In order to examine whether the participants with different diets perceived vegan food differently, the factor means were compared. The only significant differences detected among the responses of those following different diets related to the factor of "enjoyment" (Welch's $F(4, 216.15) = 59.906, p < 0.001$) (Table 4).

Table 4. Factor means per diet.

	Means 1					F-Value/Welch-Value	p-Value
	Vegans (N = 152)	Vegetarians (N = 96)	Former Vegetarians (N = 91)	Flexitarians (N = 89)	Omnivores (N = 75)		
Original ^A	−0.12	0.10	0.00	0.08	−0.11	1.171	0.323
Enjoyment ^B	0.70 ^a	0.31 ^b	−0.27 ^c	−0.49 ^{c,d}	−0.75 ^d	59.906	<0.001

¹ The mean over all diets is 0 (factors are z-scores). ^A Assumption of homogeneity of variances is met (Levene-test, $p > 0.05$). ^B Assumption of homogeneity of variances is not met (Levene-test, $p \leq 0.05$); ANOVA based on Welch-Test, post hoc test: Games–Howell. ^{a–d} Different letters indicate significant differences between means ($p \leq 0.05$).

The factors were used to group consumers into different clusters based on their attitudes towards vegan food. Using the hierarchical cluster method "single linkage", five outliers were identified and excluded from further calculations. The optimum number of clusters was identified as three in accordance with consideration of the dendrogram of Ward's hierarchical clustering method as well as by comparing the within-sum-of-squares values and the silhouette score of various k-means cluster solutions. To verify the cluster quality, the silhouette widths of the resulting clusters were checked. As can be seen in Figure 2, Cluster 1 contains four cases, and Cluster 2 contains two cases with negative silhouette width. This means that six cases overall were probably allocated to the wrong

cluster. The average silhouette width is 0.38. According to Kaufman and Rousseeuw [79] (p. 88), an average silhouette width in the range of 0.26 to 0.50 indicates that there is substantial structure in the data.

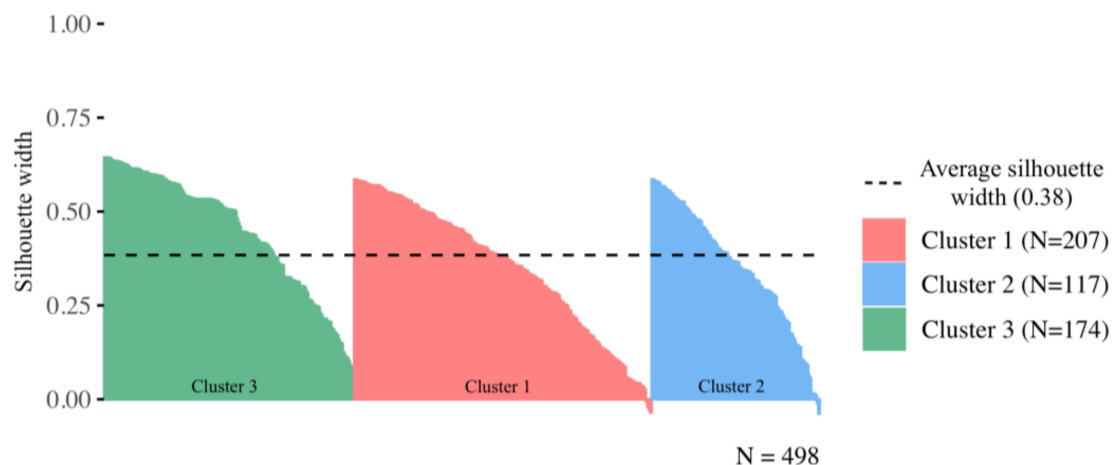


Figure 2. The silhouette plot for the three clusters.

The created clusters are shown as a scatter plot in Figure 3. Consumers allocated to Cluster 1 did not perceive vegan food as “original”, while those in Cluster 2 perceived vegan food as original but doubted the tastiness of such products. Cluster 3 included all those who perceived vegan food as both original and enjoyable.

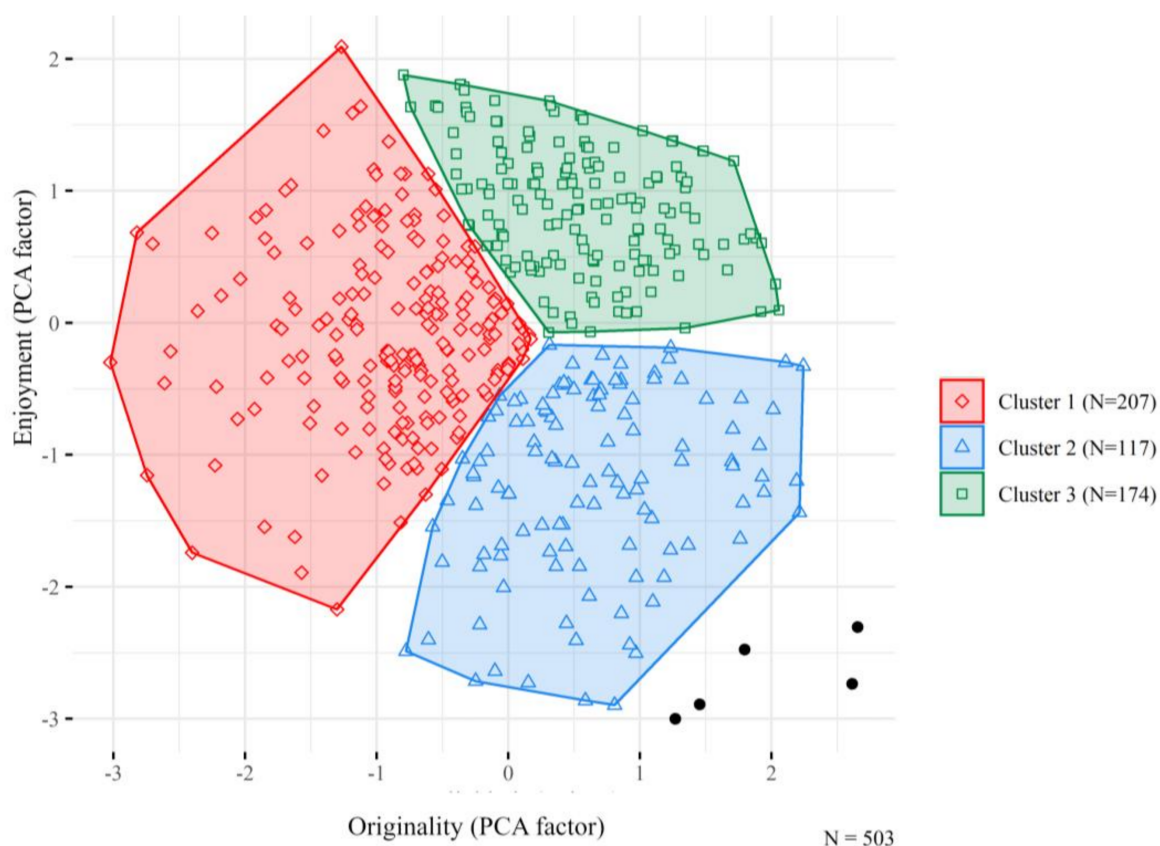


Figure 3. Scatter plot of the three clusters and the outliers (black points).

For a simpler interpretation of the results, the initial variables that were included in the principal component analysis were used. Figure 4 shows how the three clusters differ in their perception of vegan food.

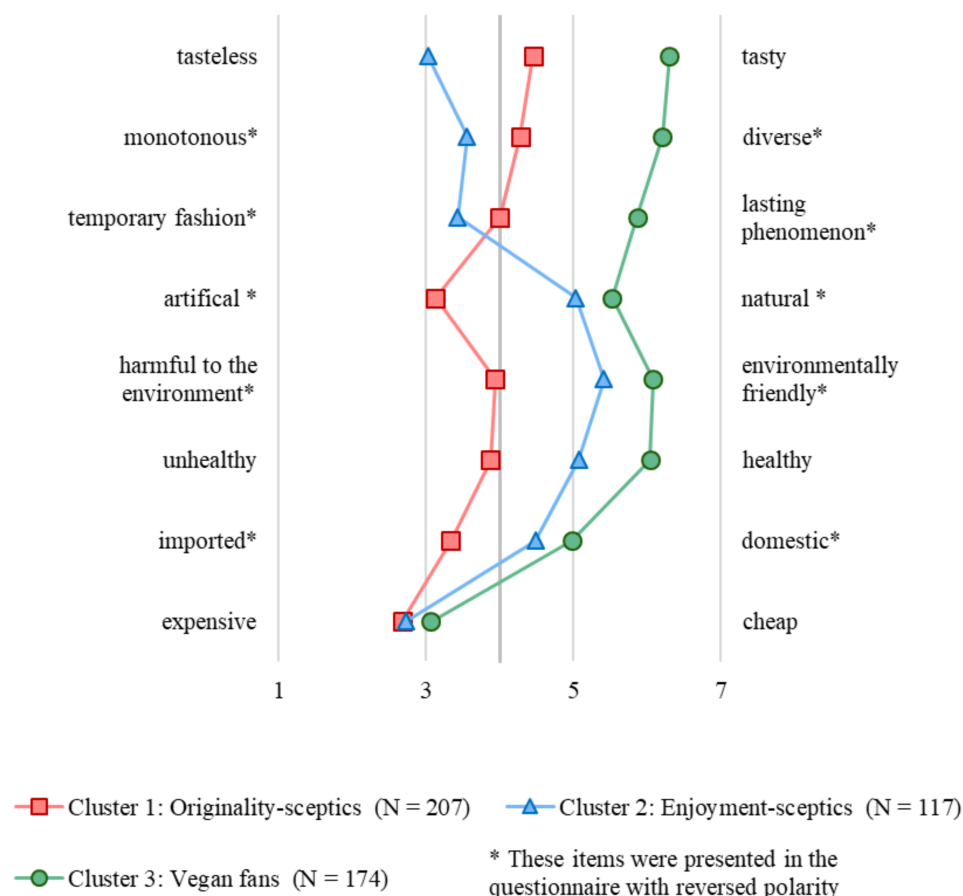


Figure 4. Perception of vegan food from the perspective of the clusters.

The three clusters were labelled “originality-sceptics” (Cluster 1), “enjoyment-sceptics” (Cluster 2), and “vegan fans” (Cluster 3). The “originality-sceptics” tended to perceive vegan food as artificial and imported and did not assess it either as healthy or environmentally friendly. The other two clusters both perceived the “originality” and “environmentally friendly” of vegan food positively, with the “vegan fans” rating these factors even more highly than the “enjoyment-sceptics”.

A significant relationship was identified between diet group and cluster membership ($\chi^2(8) = 114.757, p < 0.001$, Cramer’s $V = 0.339$). According to Cohen [80] (p. 227), the effect size can be characterised as a medium effect. There were only a very small proportion of vegans (4%) and vegetarians (9%) among the “enjoyment-sceptics” cluster. Likewise, there were less former vegetarians (11%), flexitarians (9%), and omnivores (5%) among the “vegan fans” cluster. Surprisingly, consumers from the “originality sceptics” cluster were found in almost equal proportions in all diet groups (Table 5). In terms of socio-demographic factors, the gender and age of the participants had no significant effect on the clusters to which they belonged.

Table 5. Segments of consumers: clustered groups and diet.

	N	Vegans	Vegetarians	Former Vegetarians	Flexitarians	Omnivores
Vegan fans	174	50%	25%	11%	9%	5%
Enjoyment-sceptics	117	4%	9%	24%	33%	30%
Originality-sceptics	207	29%	20%	20%	16%	15%

5. Discussion and Conclusions

The socio-demographic characteristics show there were more women than men in the sample in all diet groups except for the omnivores. In addition, the average age of vegans and vegetarians was slightly lower in the sample than in the German population as a whole. However, these characteristics have already been observed in other studies. Women are often over-represented when recruiting survey participants in grocery shops (for example [46,81]), because grocery shopping in Germany is more often done by women [82] (pp. 116–117). Furthermore, women are more often vegetarians [42,43,68,83]. A lower age is also a typical characteristic of vegetarians [68].

Although the term “flexitarian” is not very precisely defined, the reported frequency of meat consumption by flexitarians in this study is in line with the results of previous studies on flexitarians [19,61,69,84,85].

The three most frequently mentioned associations with vegan food stated by vegans and vegetarians, i.e., the issues of animal welfare, health, and environmental protection, are consistent with the most widely reported motives for choosing a vegan diet and the overall perception of veganism [44–52,86]. The conviction, that no distinction should be made between companion animals, farm animals, and wild animals often also leads to a vegetarian or even vegan diet [87].

For those participants who ate meat from time to time, only health was among their top three associations with vegan food products. In an earlier study on the reduction of meat consumption in Germany, personal reasons such as health benefits were also a frequently mentioned motive for a reduced meat consumption and altruistic reasons such as climate protection were generally of less importance [88]. While “healthy” and “natural” were stated by many participants as associations with vegan food, it is remarkable that some participants associated the terms “unhealthy” and “artificial” with these products. This confirms the results of previous studies about meat substitutes, which are perceived as healthy, but unhealthy on account of the many additives and the high degree of processing involved in the production of such substitutes [27,28]. While literature reviews have shown that giving up meat consumption is widely perceived as healthy, some people are also concerned that abstaining from meat could be unhealthy and lead to malnutrition [25,89]. In particular, many consumers are sceptical about the healthiness of a vegan diet, although a majority consider a vegan diet to be healthy [38].

The significant differences regarding the assessment of the environmental friendliness of vegan food between persons with different diets are consistent with the findings of previous studies: vegetarians are more environmentally concerned than flexitarians and meat eaters [62] and more often believe that meat production is bad for the environment [17,20,61]. However, it should also be considered that many consumers are not aware of the negative environmental impacts of meat consumption and underestimate them [90,91]. Consumers therefore wrongly perceive environmental protection through a reduction in meat consumption as less effective than other behavioural or consumption changes [92–95].

Participants who ate meat from time to time were significantly more concerned about and critical of the taste of vegan food than vegetarians and vegans. Such variations in perceptions of the taste of vegan products have been found in previous studies [34,36,37]. Importantly, the cluster analysis performed for the present study revealed a segment of consumers who have positive attitudes to vegan food but also have doubts as to the taste and variety of such food. In order to reduce the reluctance of this target group, it is necessary to underpin progress in the development of tasty products with additional communication measures and promotion. The fact that people with a vegetarian self-identity do not miss the taste of meat may be an explanation for the low proportions of vegans and vegetarians in this cluster [96].

The analysis further revealed a consumer segment with doubts about the naturalness and “originality” of vegan products. Such doubts were expressed by participants from all five diet groups. In a study by Lemken et al. [97], a similar consumer segment was

identified for whom it is particularly important that meat substitutes are only minimally processed and in a study by Hwang et al. [98] that the perception of unnaturalness of plant-based meat serves as a barrier to purchase. To differentiate from other substitute products, therefore, organic vegan food should be minimally processed and contain no additives. Serving consumers' demand for less processed foods is also advantageous for environmental and health reasons, as a high proportion of highly processed foods could reduce the environmental value and health benefits of the vegan diet [99–101].

To expand the target group for vegan food, the needs of the “originality-sceptics” and “enjoyment-sceptics” clusters should be addressed. Depending on the product, the focus may be more on the “originality-sceptics” or on the “enjoyment-sceptics”. However, special importance should be attached to the taste of vegan products since some of the “originality-sceptics” also questioned the tastiness of vegan products. Studies have shown that the perceived taste characteristics have a strong influence on the purchase probability of vegan products [24,102]. Vegan food was perceived as “expensive” by all the study respondents irrespective of their different diets, further confirming the findings of previous studies [35,36,103].

When comparing the associations to vegan food found in this study with associations to organic food in general, a large overlap emerges. A study by Hilverda et al. [104] found that “animal welfare”, “price”, “health”, “pesticide use”, and “naturalness” are the most frequently mentioned associations with organic food. Everything except “pesticide use” was also mentioned in this study as an association with vegan food. For organic food consumers, the health benefits of organic food in general are a key purchase motive, as a meta-analysis by Rana and Paul [105] shows. Other aspects such as environmental friendliness and animal welfare, which are also associated with vegan food, are further important motives for organic food consumers to buy organic food [105]. This overlap in the perception of organic and vegan food underlines the relevance of organic food consumers as a target group for vegan food.

In Germany, both vegan food and organic food in general have gained increasing public attention in recent years alongside wider public discussions about the environmental impacts of food production. It can therefore be assumed that changes in organic food consumers' perceptions and attitudes towards vegan food are of high interest to food suppliers. Given that this study provides only a snapshot of a particular consumer group in Germany, it would be of interest to ascertain the extent to which similar perceptions, consumption patterns, underlying attitudes and buying motives for vegan food exist among consumers in other countries.

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