
10. Consumer Preference and Acceptance of Plant Based Meat Alternatives

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Figure 10.1: Plant Based Meat

Abstract:

Consumers' dietary patterns have a significant impact on planetary and personal health. To address health and environmental challenges one of the many possible solutions is to substitute meat consumption with alternative protein sources. This review identifies 91 articles with a focus on the drivers of consumer acceptance of five alternative proteins: pulses, algae, insects, plant-based alternative proteins, and cultured meat. The great environmental impact of increasing animal product consumption requires the willingness to reduce or to substitute meat consumption. A possible substitute product, plant-based meat substitute, is made from plants and offers a sensory experience similar to conventional meat.

In this narrative review, we focus on the consumer acceptance of plant-based meat alternatives. We searched for peer-reviewed studies in SCOPUS and Web of Science (WoS) up to December 2021. Of all 111 records identified, 28 were eligible, and, thus, included in this narrative review. The results imply that established consumer behavior has complex socio-economic implications for the adoption of plant-based meat substitutes. Plant-based meat was consistently rated more favorably than other meat substitute products, but sensory and nutritional implications still exist. Environmental and health-related factors may contribute to the market spread of plant-based meat substitutes, but these factors alone are not sufficient. Furthermore, so far there is no information available about how the hypothetical measurements used in the studies (such as willingness to pay) will translate to real life consumer behavior. The focal areas of the intervention studies included here do not fully correspond with the current knowledge of drivers. To date, intervention studies have mainly focused on conscious deliberations, whereas familiarity and affective factors have also been shown to be key drivers. The comprehensive overview of the most relevant factors for consumer acceptance of various categories of alternative proteins thus shows large consistencies across bodies of research. Variations can be found in the nuances showing different priorities of drivers for different proteins and different segments, showing the relevance of being context and person specific for future research. Despite these barriers, there is certainly a great market potential for plant-based meat alternatives, which is expected to be more pronounced in the future, with increasing environmental and health awareness.

10.1 Introduction:

Current predictions estimate that the world population will reach 9 billion people by 2050 [1-23] combined with the rising trend of meat consumption due to income increase in industrialized countries [2], which indicates that demand for animal-source foods is likely to double by 2050. Globally, the demand for animal products has increased due to changing dietary patterns; the rising income of the middle class and population growth [7,8,9]. As incomes rise, especially in the middle class and people move to cities, diets tend to become more varied and higher in resource-intensive foods, such as meat and dairy [10]. In the developed countries, meat is relatively inexpensive and accessible but intensive meat production systems have a strong negative impact on the environment [11]. This presents an alarming threat to our planet, as meat production is an intensive and unsustainable process which causes environmental problems such as deforestation, pollution, damage to hydro geological reserves, and loss of biodiversity [3]. Livestock provides 25% of total protein in the diet and leads to several critical global problems including consumption of fresh water, fossil fuel, and land, besides emissions of greenhouse gas [4]. The livestock sector alone is responsible for 14.5% of human-made greenhouse gas emissions [5] and uses almost 30% of the world's fresh water resources [6]. Overconsumption of red meat in Western countries contributes to the development of cardiovascular disease due to the high saturated fat content [27]. This represents a major public health issue, where heart disease is the leading cause of death [28]. Thus, identifying high-quality meat alternatives that mimic traditional meats may more effectively appease consumers without compromising the sensory qualities of meat products. Pulse-based meat alternative products are attractive as they have reduced carbon emissions and contribute to slowing global warming [25]. Legume-based meat alternatives and animal products have an overall comparable socio-economic performance. Although there are concerns about lower farm-level profitability at

production, there are socio-economic gains at the processing stage and in legume-based products [26]. Compared with conventional meat, plant-based meat uses 72% to 99% less water and 47% to 99% less land. Further, it causes 51% to 91% less water pollution and 51% to 91% less aquatic nutrient pollution, and emits 30% to 90% less greenhouse gas emissions [29, 30]. Analysis of the environmental impact of plant-based meat show that plant-based meat production uses 72–99 percent less water and 47 to 99 percent less land. Further, it causes 51–91 percent less water pollution and emits 30 to 90 percent less greenhouse gas emissions. Apart from it providing sustainability, if fortified efficiently with minerals like iron and vitamins like vitamin B12 and B6 can increase its nutritional quality and its demand. Plant-based meat alternatives present opportunities and threats to animal meat producers in rural regions [30]. Due to these tendencies, a substantial dietary shift is required, especially in Western countries [7,15,16] and it has become necessary to reduce meat consumption in particular areas [10-17]. In addition to an actual reduction in consumption and a shift to different types of diets, plant-based substitutes, laboratory-grown meat and even edible insects have commonly been identified as possible solutions to reduce meat consumption [18,19]. The environmental gains of relying on non-animal protein sources such as plants, insects, fungi, and algae are quite significant.

A complete switch to non-animal proteins in the human diet would reduce the use of natural resources currently dedicated to the livestock sector by 35–50% [20]. In Western countries, plant-derived proteins are more popular than other alternative proteins [21]. Soy products like tofu and tempeh which originate from Asian countries, have been commercially available in the West since the 1960s and are now accepted by vegetarians and vegan consumers who avoid eating meat for ethical, environmental, or health reasons [22]. However, such products are not as popular among meat-eaters and flexitarians due to their low sensory appeal [23]. But to perfectly mimic the animal meat, the ingredients of these meat analogues should be specific and in appropriate quantity to attain similar sensory qualities. Sensory evaluation, in the context of meat analogs, provides important information regarding the selection of processing methods and use of novel ingredients to achieve meat-like sensory attributes by providing both quantitative and qualitative data on taste, flavor, texture, and appearance which helps in gaining consumer preference and acceptance [30].

A. Plant-Based Ingredients for Meat Alternatives:

The general ingredients which are required in the formulation of plant-based meat alternatives are discussed in the following table 10.1 [24].

Table 10.1: Plant-Based Ingredients for Meat Alternatives

Ingredient	Plant Sources
Protein	Pea, Soy, Wheat(gluten), Lentils, Seeds (sunflower, pumpkin, rapeseed), Peanut, Potato, Zein, Hemp
Binding and Texturizing Agents	Methylcellulose, tapioca starch, Potato starch, Konjac flour, Carrageenan, Xanthan gum
Fat and Oil Substitutes	Coconut, Rapeseed, Sunflower, Canola, Corn, Soy, Palm, Sesame Oil

Ingredient	Plant Sources
Coloring Agents	Paprika oleoresin, Lycopene and Red yeast rice
Flavoring Agents	For Umami Taste: amino acids (soy, tamari). For Meaty Taste: mushroom powder
Flavor Enhancers and Sweeteners	Miso, Yeast extract, Maple syrup
Other Spices	Paprika, Black pepper, Onion powder, Garlic, Salt

B. Types of Meat Alternatives and their Brands:

Various types of plant-based meat alternatives are available in the market and some of the products include burgers, patties, sausages, ground meat, chicken, seafood(shrimp), pork, beef, bacon, meatballs, meat crumbles, jerky, hot dogs, meat pies, steaks, chicken nuggets, deli slices and kebabs Brands which provide these analogues include Beyond Meat, Daiya Food Inc., Vbites Food Ltd., Danone SA, Eden Foods Inc., Plasmil Foods Ltd., Archer Daniels Midland Company etc majorly from Europe.

Nowadays, we are already witnessing an unprecedented growth of meat substitutes in the Western market. The market potential was certainly high in the past decade and the year 2020 was a record-breaking year for plant-based related sales and investments globally.

Plant-based meat retail sales reached USD 4.2 billion globally with a 24% growth compared to 2019. Despite these events, the consumer acceptance of novel and unfamiliar foods is still a challenge to market stakeholders [33] and consumer acceptance of meat substitutes are still low [19] or uncertain [7] in several countries.

10.2 Method:

The aim of this review is to provide qualitative analysis and interpretive approach towards the result; thus, context is wider. Instead of subjective selection bias, rigorous systematic research was followed.

Two types of methods were followed, one included research of various studies and the other was a personalized survey. The steps of the research strategy were the following:

Choosing the databases: Scopus is the largest abstract and citation database of peer reviewed literature according to a literature search in 2020. The search was done via Scopus, Web of Science (WOS) and ScienceDirect.

Choosing the key words. The term “plant-based meat” was combined with the keywords “consumer acceptance”, “consumer adoption”, and “consumer purchase”. Furthermore, a different search was made with the term “plant-based burger”, a product which was introduced early on the market and has been in the focus of several studies.

Evaluating the articles and collecting the results based on different themes. Articles were evaluated based on their final content, which resulted in further exclusion. The final pool of studies consisted of 28 items (21 studies and 7 large-scale survey reports)

Table 10.2: Method

Inclusion	Exclusion
Concerns consumer behavior or acceptance of alternative protein sources	Only concerns technical or ethical aspects of alternative protein sources
Contains empirical data (e.g., focus groups, surveys, experiments)	Reviews, opinion papers, conference papers and abstracts, concept articles
Focuses on understanding, explaining, or influencing consumer acceptance or purchase behavior regarding alternative proteins	Is unrelated to consumer behavior
Concerns protein <i>sources</i> (product level) instead of <i>proteins</i> (nutrient level)	Concerns trends in food or meat consumption patterns
Full-text paper written in English and published in a peer-reviewed journal	Concerns animal welfare or hunting and eating wild animals

Personal Survey: It was a generalized survey conducted online via google form in order to analyze preferences of the population about plant-based meat alternatives on the ground level. The survey included 13 questions related to topic apart from personal information. For an easy understanding, the table 10.3 showcase the questionnaire.

Table 10.3: Personal Survey

Serial No.	Question	Options
1	Age	<ul style="list-style-type: none"> • Below 13 • 13-20 • 20-30 • 30-50 • Above 50
2	Gender	<ul style="list-style-type: none"> • Male • Female • Other
3	Location	<ul style="list-style-type: none"> • US • Canada • India • Europe

Serial No.	Question	Options
		<ul style="list-style-type: none"> • Other(specify)
4	Type of diet followed	<ul style="list-style-type: none"> • Vegetarian • Non vegetarian
5	Introduced to plant-based meat	<ul style="list-style-type: none"> • Yes • No
6	Consumption of plant-based meat alternatives in diet	<ul style="list-style-type: none"> • Daily • Weekly • Monthly • Rarely • Never
7	Reasons of Consumption	<ul style="list-style-type: none"> • Health • Environmental concern • Ethical or animal welfare • Dietary restrictions • Other(specify)
8	Product Preferences	<ul style="list-style-type: none"> • Burger • Sausages • Chicken substitutes • Seafood substitutes • Other(specify)
9	Brand Awareness	<ul style="list-style-type: none"> • Yes(specify) • No
10	Taste and texture	<ul style="list-style-type: none"> • Very satisfied • Somewhat satisfied • Neutral • Somewhat dissatisfied • Very dissatisfied
11	Price consideration (willing to pay premium)	<ul style="list-style-type: none"> • Yes • No • Depends

Serial No.	Question	Options
12	Information sources	<ul style="list-style-type: none"> • Online and social media • From family or friends • Packaging labels and nutritional information • In-state promotion • Other(specify)
13	Adoption in restaurants and fast-food choices	<ul style="list-style-type: none"> • Yes, appreciate • No, don't care • No, prefer traditional meat
14	Barrier to consumption	<ul style="list-style-type: none"> • Taste, texture and appearance • Nutritional quality • Price • Availability • Cultural and dietary preferences • Less awareness and information • Social and peer pressure
15	Future interest	<ul style="list-style-type: none"> • Very interested • Somewhat interested • Not interested
16	Additional comments	<ul style="list-style-type: none"> • (Anything else share)

10.3 Results and Discussions:

The literature research shows that the research field on alternative proteins is developing rapidly. The results reveal an unequal distribution of articles across the different alternative proteins. There are 9 articles on pulses, 9 on algae, 58 on insects, 9 on plant-based meat alternatives, and 16 on cultured meat. The majority of the studies were conducted in the Netherlands (20 studies), Italy (17 studies), Germany (13 studies), the United States (9 studies), Australia (8 studies), Belgium (7 studies), the United Kingdom (5 studies), and Switzerland (6 studies). Other countries, such as the Czech Republic, are only represented once or twice. Numerous studies compare the acceptance of alternative proteins to that of traditional meat, revealing that alternative proteins are evaluated significantly less positively. Acceptance levels vary across segmentation criteria of demographics and lifestyle. Demographic variables were generally found to be less relevant compared to social and psychological factors in understanding consumer acceptance. The three lines of driver's acceptance are (1) product-related factors, (2) psychological factors, and (3) external attributes

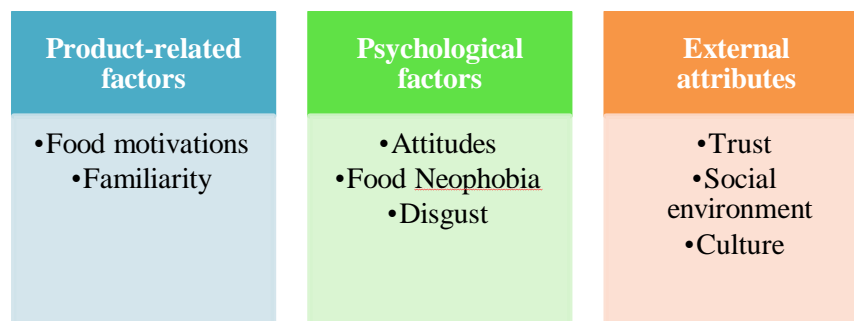


Figure 10.2: Product-Related, Psychological Factors and External Attributes

Product-related factors: The category of drivers refers to product properties and product-related motivations and associations, including being familiar with products.

Food motivations: The results show a range of product-related drivers that are significant in consumer acceptance of all included alternative proteins: healthiness, taste, convenience, environmental benefits, and appearance. There may be variations between individuals and between the experiences of users. A study by House (2016), for example, revealed that motivations for eating insects for the first time substantially differ from factors influencing repeated consumption of insect-based food (e.g., price, taste, availability), indicating the importance of differentiating between a first trial and repeated behavior.

Familiarity Individuals have a tendency to behave in similar ways as they are used to behave and to choose options that are already known. A number of studies demonstrating the relevance of some form of familiarity as a driver of the acceptance of insects (59%) compared to that of cultured meat (33%), plant-based meat alternatives (27%), algae (20%), and pulses (0%). Moreover, familiarity seems to play a more prominent role when products are novel for a consumer, e.g., familiarity was less important for heavy users of various meat substitutes in explaining their acceptance compared to non-users and light or medium users. Non-users had a higher tendency to avoid new food.

Psychological factors: Individuals may exhibit distinct factors that explain variations in acceptance of alternative proteins. The personal characteristics that demonstrate consistent results are attitudes, and food neophobia and disgust.

Attitude: Attitudes are consistently shown to be relevant in explaining intentions to consume alternative proteins; this seems to apply to all alternative proteins. Moreover, attitudes seem to differ between groups of individuals—for example, between non-users, light and medium users, and heavy users of meat substitutes. Non-users have a very positive attitude toward meat, while heavy users have more positive attitudes toward meat substitutes.

Food neophobia: Novel meat alternatives may attract neophilic consumers who seek new food alternatives and are not scared to try novel foods (i.e., drivers of food neophobia, fear, and disgust). The acceptance of all alternative proteins is affected by food neophobia; however, insects reveal a broader group of affect-related feelings that explain acceptance of specific products (i.e., mostly insect-based products).

Disgust: General disgust, affective attitudes toward eating insects, fear, and possible negative evaluations by family or friends all negatively affect willingness to eat specific insects. In accordance with these findings, show that affective drivers are more relevant for innovative alternative proteins of insects and seaweed (compared to less innovative alternative proteins of pulses and fish), indicating that acceptance of innovative alternative proteins is based more on feelings than is acceptance of less innovative alternative proteins.

External Attributes: Consumers use external factors to form an opinion on these products. The results of our review and of previous studies reveal three types of external attributes: trust, social environment, and (cultural) appropriateness.

Trust: Generally, a low number of studies include trust in their research (three studies out of 90 included studies). The findings on trust reveal a positive association between trust and acceptance of alternative proteins.

Social environment: Social norms provide information on appropriate behaviour via the perception of behaviour and opinions of others. Social norms are generally shown relevant drivers of behavior. Multiple studies consistently refer to the influence of the social environment on acceptance of alternative proteins.

Cultural appropriateness: Only studies on insects reveal the relevance of cultural traditions (i.e., alternative proteins not accepted because perceived as inappropriate in one's own culture).

10.4 Miscellaneous Reasons of Consumer Acceptance Towards Plant Meat:

Dietary Preferences: The willingness to replace or reduce the consumption of meat can depend to a large extent on current dietary habits. Research to date suggests that the willingness to try plant-based meats is high compared to other alternatives, but the proportion of people who frequently consume meat substitutes is low within the population. We defined the dietary lifestyles in a similar way to the Smart Protein survey.

Omnivore individuals consume meat frequently and their diet includes all food groups. Flexitarian individuals consume meat, but they intend to reduce their meat intake and consume higher share of plant-based foods.

Pescetarian individuals consume seafood but no other types of meat. Vegetarian individuals do not consume meat but consume other animal-based products, such as eggs or dairy. Finally, vegan individuals do not consume animal-based products at all.

Education: In the USA, higher education tended to be associated with a higher preference for a non-beef alternative [29], higher weekly consumption of plant-based meat substitutes [20] and stronger preferences for alternatives [30].

Another research study found a negative statistically significant association between education and willingness to buy plant-based meat alternatives in Korea [27], willingness to pay in India [27] and the purchase intention in South Africa.

Income and Price Consideration: Income had a positive effect on purchase intention in India, where 13.4% of respondents were not at all likely to pay a higher price for plant-based meat substitutes and 52% were very or extremely likely to pay a higher price [29]. At the same time, other research found no significant effect of income on willingness to pay for plant-based meat substitutes in India. However, respondents were willing to pay a premium for plant-based meat substitutes (1.97 \$/kg) over the price of conventional meat (aggregating across all four segments), which differed across the consumer segments in terms of value and sign of the relationship [27].

Age: In the USA, the younger generation (18–34 years old) consumed plant-based meat substitutes more frequently and were open to consume it in a variety of locations, while interest in eating plant-based meat substitutes decreased with age. This could be due to the fact that a significantly higher proportion of respondents were following plant-based, vegetarian, or vegan diets compared to other age classes. Furthermore, a significantly higher proportion of younger and middle aged (35–54 years old) respondents consumed plant-based meat alternatives because of environmental/sustainability benefits, texture, or religious or moral reasons. Respondents above 55 years old were more likely to not consume plant-based meat substitutes due to a lack of interest.

Gender: Among older European consumers, more females were identified as eco-friendly consumers compared to the ‘meat lovers’ cluster (55% vs. 42%), where the acceptance of plant-based protein was higher. Furthermore, men were more likely to choose the non-beef alternatives [29]. However, other research analyzed found no difference in the intention to purchase plant-based meat substitutes in the USA [29]. Other studies have found no significant difference in terms of willingness to pay or purchase intention in India [30], willingness to buy in Korea [27], or purchase intention in South Africa [17].

10.5 Analysis of Survey:

According to the responses of the online survey and their results, possible assumptions and conclusions can be made. Following graph shows the percentage of views of people regarding the questions respectively.

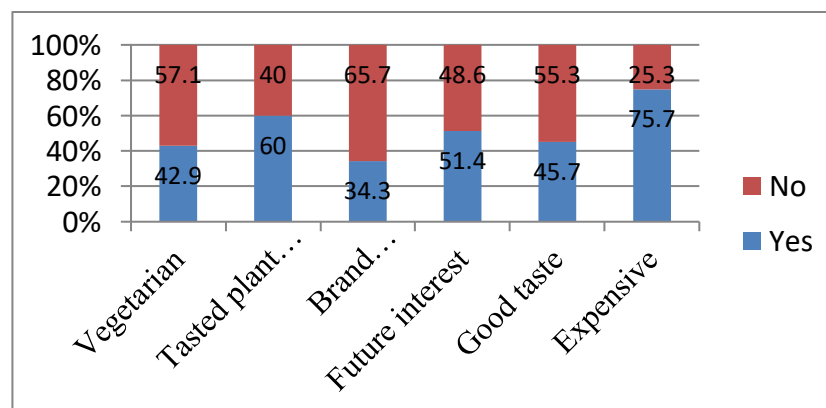


Figure 10.3: Analysis of Survey

Following are the graph charts representing the answers to the questions:

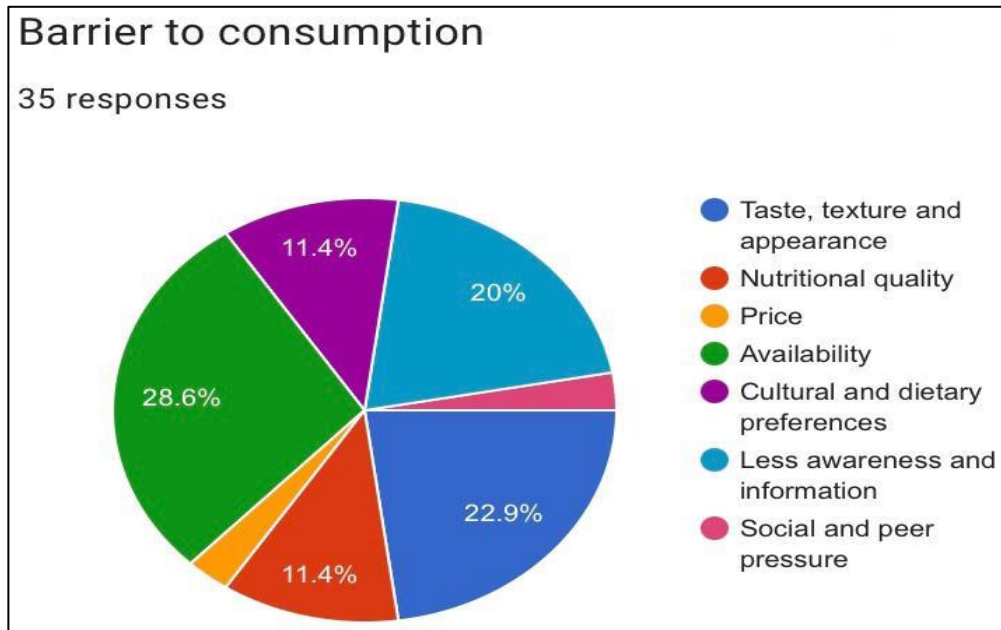


Figure 10.4: Barrier to Consumption

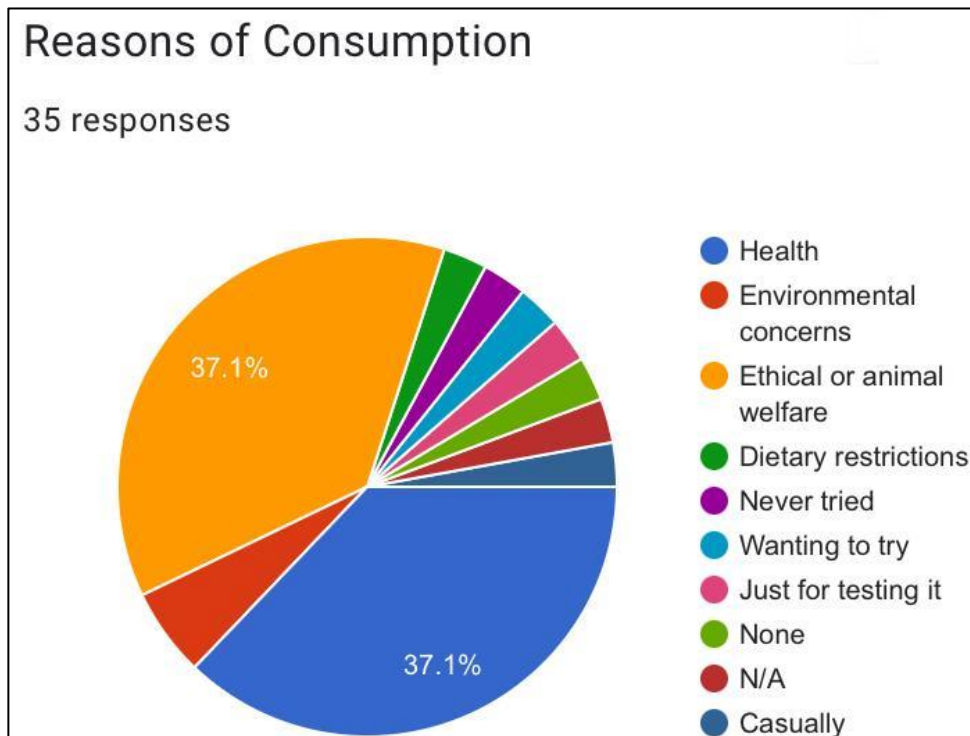


Figure 10.5: Reasons of Consumption

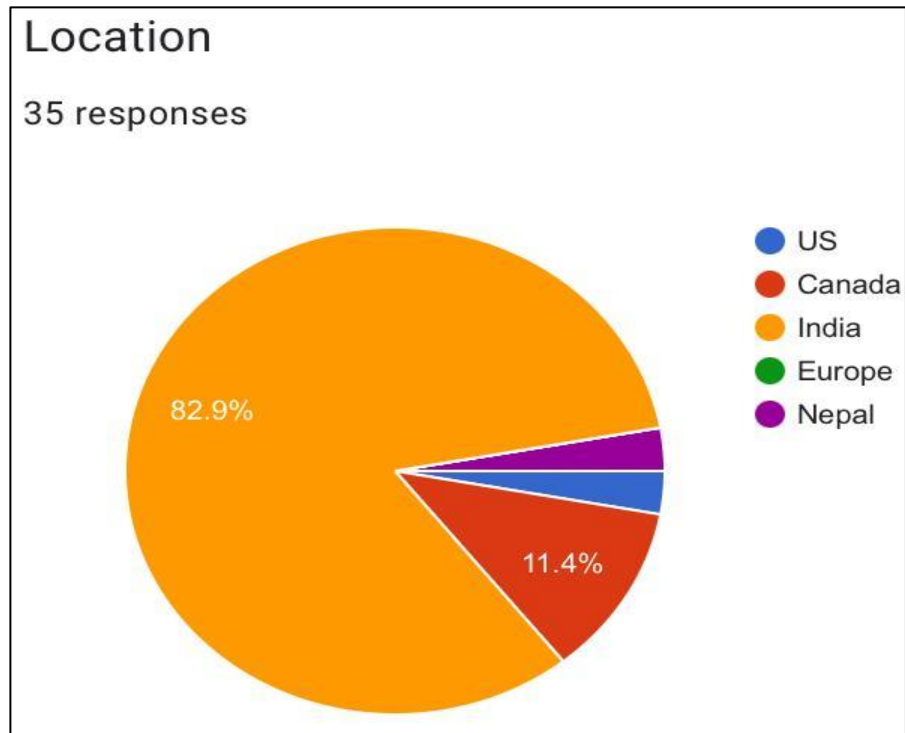


Figure 10.6: Location

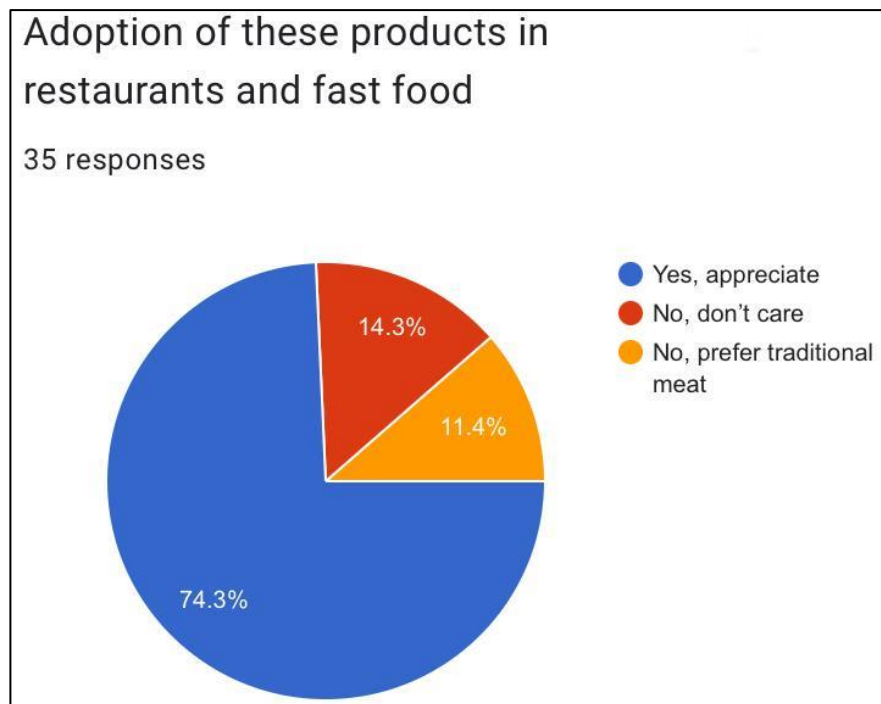


Figure 10.7: Adoption of these Products in Restaurants and Fast Food

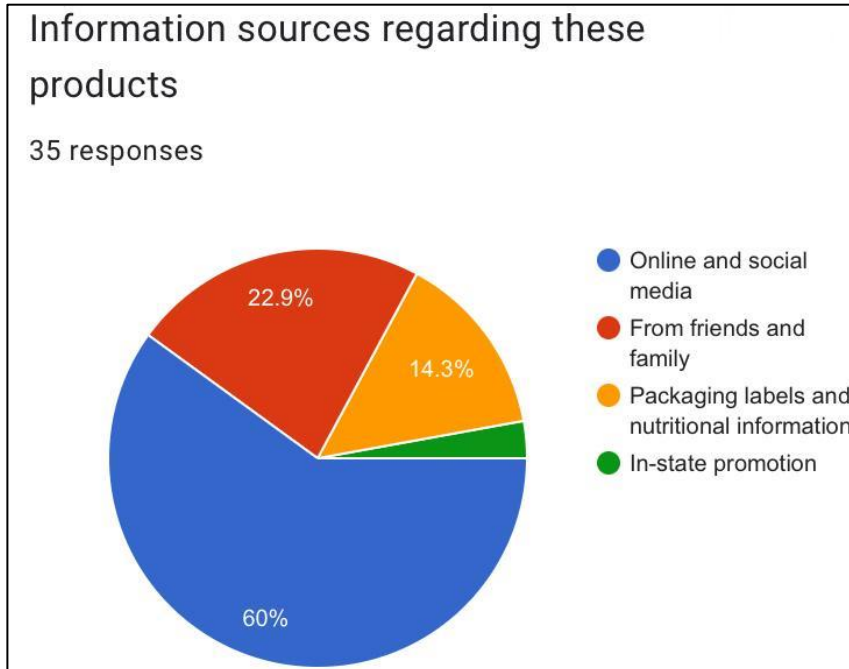


Figure 10.8: Information Source Regarding Product

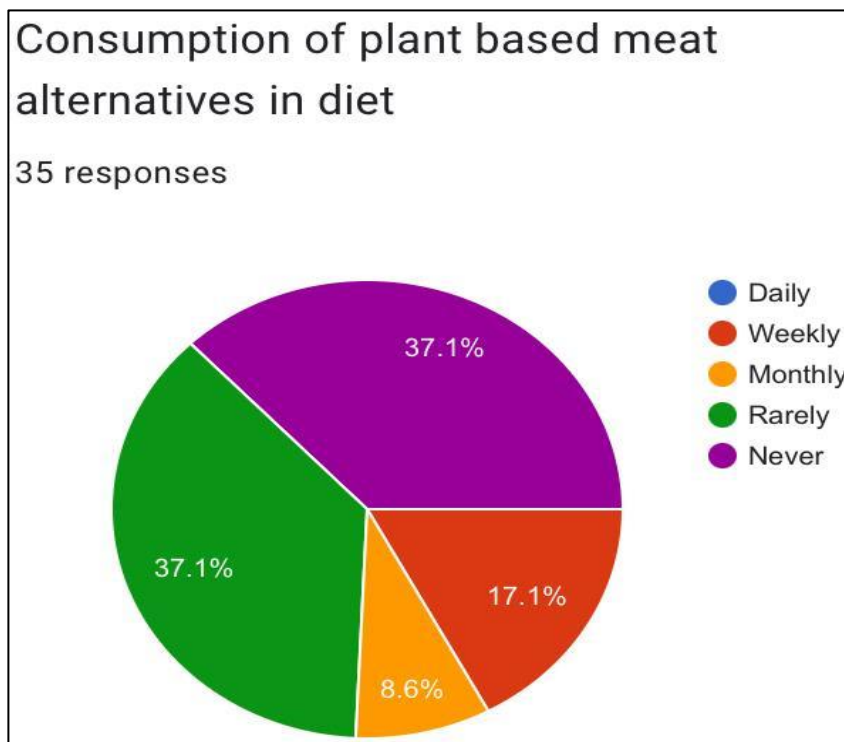


Figure 10.9: Consumption of Plant Based Meat Alternatives in Diet

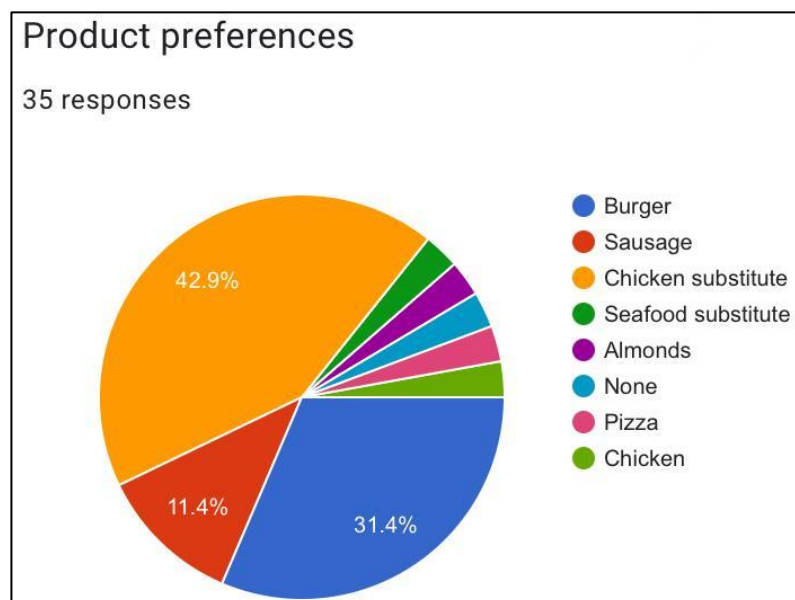


Figure 10.10: Product Preferences

On the basis of the above results, we can conclude that the plant-based meat substitutes are still priced at a premium compared to conventional meat. In addition to taste and texture, a competitive price is crucial in market penetration. No complete dietary change is required, but a transition to sustainable food consumption is necessary. Overall, the results were positive and higher willingness to try is predicted.

Future Aspects: Plant-based meat substitutes appear to fit more in the “niche” category [29], but in general, alternative proteins have morphed from a niche product to a mainstream phenomenon. There is clearly future market potential for plant-based meat substitutes [29], especially in China and India [39]. Other regions may also emerge; for example, South Africa based on its great interest in plant-based meat substitutes [17]. North America and Europe can be considered the most mature markets for alternative proteins, although the Asia-Pacific region may provide the largest opportunities. In this region, population growth, rising incomes and increasing protein consumption drives the market [10,78]. In developing countries, other aspects may emerge as well. For example, local food security was an important predictor of purchase intention in South Africa [17], which can be taken into account in future research. Still, the future for plant-based meat alternatives remains highly uncertain, since part of the current demand may only be a result of novelty and not a long-term trend [29]. Furthermore, the speculative nature of the estimates has to be taken into account, since the superior performance of plant-based foods largely results from a hypothetical large-scale adoption [38]. Future research should cover how plant-based meat substitutes may implement product and marketing strategies from the milk and other dairy alternative market, since these products are the most widely used alternative-protein products [10]. Furthermore, there remains the question of how much consumer acceptance can be hindered by previous bad experiences/memories of “classical” meat substitutes (such as tofu) [18-30], or how much it can be facilitated by blended products, such as meat hybrids [23].

Other research has highlighted that it would be important to screen new protein sources that may mimic meat without excessive human manipulation, while providing a balanced amino acid profile with the complementary addition of multiple plant-based proteins [8]. To reinforce the adoption of meat analogue products, further research should also focus on the intervention effectiveness of reducing meat consumption. The effectiveness of these interventions was shown to depend on similar factors that increase consumer acceptance of meat analogue products

10.6 Conclusion:

The findings of the current review provide a comprehensive overview of the consumer acceptance of multiple alternative proteins. Although consumer acceptance varies greatly across alternative proteins, such that plant-based proteins are far more accepted than others like insects, the results also reveal consistencies in the drivers of consumer acceptance. The relevant drivers for consumer acceptance of all alternative proteins were food choice motives (especially healthiness and taste), familiarity, attitudes, food neophobia, disgust, and social norms. Besides these consistencies the review also shows the relevance of being specific and taking variations between individuals and alternative proteins into account. Future research is necessary with a focus on comparisons. Plant-based meat substitutes can play a crucial role in reducing the burden on the environment and, thus, in the fight against climate change. More than two-thirds of consumers were usually identified as omnivores; thus, meat played an important role in the average diet. Overall, the results were relatively consistent in that prior positive experience and knowledge predicted higher willingness to try.

It was likely that consumers with higher incomes were more likely to choose plant-based alternatives, and specific groups were willing to pay a higher price for such products. However, plant-based meat substitutes are still priced at a premium compared to conventional meat. In addition to taste and texture, a competitive price is crucial in market penetration. Environmental factors played a decisive role, but environmental reasons alone are not likely to be sufficient to cause a large-scale dietary shift. A separate issue is what consumers consider to be sustainable or healthy. Based on the results, it was clear that the environmental impact of plant-based meat substitutes was substantially lower compared to the average diet.

Health considerations were also important, although, highly processed plant-based meat substitutes are not necessarily healthier than conventional meat dishes. Taste and texture are critical, but it is also advantageous that there is no significant difference in terms of texture between plant-based and conventional meats. Increased emphasis on environmental and health related arguments could help to promote the uptake of these products. However, this also requires a competitive price. One of the greatest challenges seems to be related to the hypothetical nature of the measurements used in the studies (willingness to purchase or willingness to pay for example). So far, there is no information about how these measurements will translate to real life consumer behavior. Despite these barriers, there is certainly a great market potential for plant-based meat alternatives, which is expected to be more pronounced in the future with increasing environmental and health awareness. Finally, it is worth emphasizing that what is required is not a complete dietary change, but a transition to sustainable food consumption in incremental steps.

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