

A segmentation of the expected future *in vitro* meat market: a study in Vietnam

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Abstract

In vitro meat is a fairly new product on the market. As a result, public opinions about this new product are still uncertain and conflicting. This research continues to extend previous studies by implementing a segmentation of the potential consumer market for *in vitro* meat. Using data gathered from young consumers in Vietnam (n = 393), this study identified three distinct segments: pessimists, optimists, and mainstreamers. Among the three, the optimists, who might account for approximately a quarter of the whole market, could be considered to have the greatest potential to purchase *in vitro* meat, given their positive perception of the ethical and personal impacts of its production. Characteristics of this segment include familiarity, emotional attachment, and sensation-seeking tendencies. The theoretical and practical implications of this research are further discussed.

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1. Introduction

In vitro meat (artificial meat, cultured meat, or lab-grown meat) is a relatively new product on the market. Different from the traditional meats that are produced by killing animals, *in vitro* meat is grown from animal cells under lab-controlled physical and chemical conditions using the *in vitro* technique. This technique was initially introduced in the early 1900s (Goodwin and Shoulders, 2013). A century later, a patent application for the Industrial Production of Meat Using Cell Culture Methods was filed in 2005. And the first *in vitro* meat burger sample was offered to the public in 2013, the results of a budget of more than 300,000 USD spent during two years of research (Fountain, 2013). Yet, the global *in vitro* meat market is estimated to be worth merely 214 million USD in 2025 and 593 million USD in 2032, respectively (Research and Markets, 2019). The regional markets are potentially divided among Europe (40%), Asia Pacific (25%), North America (15%), South America (10%), and the Middle East and Africa (10%). The Asia Pacific, thus, can become the second-largest market of *in vitro* meat in the upcoming years.

Generally speaking, public awareness of *in vitro* meat has been increasing since 2005. By analyzing 34 news articles published between 2005 and 2011, Goodwin and Shoulders (2013) found that the public

understood that *in vitro* meat had several benefits, which were related to the environment, animal welfare, food security, and human health. However, they were also sceptical about the future of *in vitro* meat due to the newness and unnaturalness of this product. In another study, Laestadius and Caldwell (2015) decoded more than 800 news-reader comments and discovered a diverse range of perspectives from the public as of August 2013. These perspectives included, for example, *in vitro* meat's impacts on the environment, animals, public health, scientific development, culinary development, and structural-economic issues, among others. Recently, a review of academic papers published during the 2014-2018 period conducted by Bryant and Barnett (2018) added that potential consumers also cared about price and quality, as these factors could affect their intentions to buy and eat *in vitro* meat. Another analysis by Painter *et al.* (2020) of the US and UK media in the 2013-2019 period revealed that developers were spreading positive information about this new type of meat. However, a recent study in China showed that local customers (approximately 70%) were almost completely unaware of *in vitro* meat (Zhang *et al.*, 2020). Those who were aware of the new products might not want to eat *in vitro* meat due to their perception of its absurdity or disgusting, safety, and unnaturalness (Liu *et al.*, 2021).

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Overall, present customers' opinions of future *in vitro* meat are largely connected to two major issues. First, they are well aware of the ethical aspects of *in vitro* meat, including those involving the environmental, socio-economic, and cultural benefits and harms of this new product (Goodwin and Shoulders, 2013; Laestadius and Caldwell, 2015; Sun et al., 2015; Bhat et al., 2017; Malavalli et al., 2021). Second, they care about certain factors that may affect them personally (either positively or negatively), for example, quality and price (Bryant and Barnett, 2018). The future of the *in vitro* meat market is undoubtedly affected by these important factors. It should be noted that these two factors reflect rational thinking, the cognitive element of customers' perception (Agapito et al., 2013). The cognitive impressions can be positive or negative, showing different levels of profits or risks of *in vitro* meat as perceived by potential customers. And since a certain sense of risk does exist, customer perception may be influenced by their tendency to explore and try new things (sensation seeking) (Fuchs, 2013; Zhang et al., 2016).

Previous studies, thus, have carefully examined customers' opinions about *in vitro* meat. They, nonetheless, have largely neglected the segmentation of this market (Szejda et al., 2021). Empirical evidence, however, suggests that customers in different countries perceive *in vitro* meat differently (Verbeke et al., 2015; Bekker et al., 2017), and not all of the customers in a country are potential customers of *in vitro* meat (Graça et al., 2015; Wilks and Phillips, 2017; Mancini and Antonioli, 2019). In addition, prior research has mainly focused on developed markets in Western countries. The situation in the developing ones, especially those in the East (Zhang et al., 2020; Liu et al., 2021), is mostly unknown.

Therefore, this study continues to extend previous studies by implementing a segmentation of the potential consumer market for *in vitro* meat based on their opinions (including their perception, familiarity, and attachment) about this future food product. In this study, perception is regarded as the customers' thoughts about *in vitro* meat. It includes two essential elements: ethical and personal. In addition, familiarity is considered as the extent to which an individual is technically exposed to the information about or is habitually adapted to the consumption of alternative meat or protein-linked products, such as *in vitro* meat, imitation meat or plant-based meat, beans, nuts, and insects, among others. As a cognition-based notion (Agapito et al., 2013), customers' familiarity may have an association with their perception (Fischer and Frewer, 2009; Verbeke et al., 2015; Bekker et al., 2017). Moreover, attachment is considered as the

extent to which an individual is emotionally involved with the consumption of alternative meat products, including *in vitro* meat. Different from familiarity, attachment can be regarded as an affect-based concept (Agapito et al., 2013). Nonetheless, customers' attachment can also influence their perception (Schouteten et al., 2016; Siegrist et al., 2018; Styliadis, 2018; Liu et al., 2021). Furthermore, customers' evaluation of attachment and familiarity may be affected by their sensation-seeking tendency (Innamorati et al., 2018).

This study is set in the context of Vietnam, a potential developing market in the Asia Pacific region, where consumption and import of meat and meat products are expected to continually rise over the next ten years (Organization for Economic Co-operation and Development [OECD] and Food and Agriculture Organization of the United Nations [FAO], 2019). The outcomes of this study will help to enrich the literature about the *in vitro* meat market. In addition, they are meant for those in the market as the most feasible segments for *in vitro* meat in the future are identified, indicating the most likely successful directions for *in vitro* meat production and commercialization.

2. Materials and methods

2.1 Questionnaire development

This study adopted a quantitative method of segmentation. As suggested by the existing literature, two perception factors were used as the segmentation criteria: ethical evaluation and personal impact evaluation. In addition, three elements were employed as the differentiation criteria: familiarity, attachment, and sensation seeking.

Regarding familiarity, there are three levels. At the lowest level, information may provide knowledge of and kindle interest in *in vitro* meat and other alternative products. Some information inputs might help change the public's attitudes (Verbeke et al., 2015; Bekker et al., 2017). At the middle level, personal experience and habits are doubtlessly antecedents of customers' familiarity. Those who have eaten imitation meats and other alternative products must be more familiar with these products than those who have not. Finally, at the highest level, one's culture can also affect one's familiarity. When one is more experienced with unconventional alternatives (e.g., people in China and Vietnam are more tolerant of and consuming a diverse range of meats and alternatives such as insects than people in the West; Looy et al., 2014), one may be more likely to accept a new product such as *in vitro* meat. Such an acceptance reflects certain degrees of

customers' sensation-seeking behaviour (Zuckerman, 1990).

Concerning attachment, there are two directions. In one direction, many customers may feel disgusted about the unnaturalness of *in vitro* meat. This kind of negative attachment may consequently decrease their willingness to try this new product (Siegrist et al., 2018; Liu et al., 2021). In another direction, those who treat *in vitro* meat and other alternative products with approval or fondness may be more open to their acceptance (Schouteten et al., 2016). In other words, the effect of this kind of positive attachment is the opposite of what a negative attachment would produce.

A structured questionnaire was developed to gather the data. Specifically, the segmentation criteria items were adapted from previous studies (Goodwin and Shoulders, 2013; Hocquette et al., 2015; Wilks and Phillips, 2017; Mancini and Antonioli, 2019). The respondents were asked to evaluate the ethical (5 items) and personal (5 items) criteria regarding *in vitro* meat, assuming their presence in Vietnam's market in the next ten years. These instructions were included since *in vitro* meat was not available in Vietnam at the time of the survey, and the market is forecast to be large enough for proper consideration in such a period (Research and Markets, 2019). The criteria were evaluated on a five-point scale, ranging from totally disagree to totally agree. This scale has also been used by previous studies targeting Vietnamese consumers (Nghiêm-Phú, 2021).

The differentiation criteria were also developed based on the literature about the frequency of eating certain sources of protein (familiarity, ten items) and the intensity of emotional response toward *in vitro* meat (attachment, 13 items) (Bernstein et al., 2010; Graça et al., 2015; Schouteten et al., 2016). The former criteria were rated on a three-point scale (never, occasionally, and regularly), while the latter were graded on a five-point scale (totally disagree – totally agree), similar to previous research.

In this study, a young population, those currently in their 20s (Generation Z), was purposely chosen given the fact that 10+ years from now, in 2030 and beyond, these customers will be in their 30s and will be the major buyers and eaters of meat products, including *in vitro* meat. Since the targeted population was a young one, only biological sex (male or female) was included in the questionnaire as the major socio-demographic criterion. Other criteria, such as income, education, and marital status, were not included because they will definitely change when the participants are older. Instead, a personality trait, sensation seeking (Zuckerman, 1990), was added (8 items) since it is considered to be stable

over time (Gustavsson et al., 1997; Cobb-Clark and Schurer, 2012). This trait was further structured by four smaller components: experience-seeking, boredom susceptibility, thrill and adventure seeking, and disinhibition.

Only the sensation-seeking original scale already had a Vietnamese version (Nghiêm-Phú, 2021). Therefore, the researcher translated the other scales from English to Vietnamese with the assistance of Google Translate (translation-back-translation process). The translation was further commented on and approved by an independent researcher who was fluent in both languages. After that, the questionnaire was pretested on a group of 35 university students at a national university in Hanoi to check its face validity. The outcome suggested that the respondents could understand and respond to the questions, and no correction or adjustment was needed. This questionnaire, therefore, was retained and later used for the main survey.

2.2 Data collection and analysis

The main survey of this study was implemented over a period of two weeks in late January and early February of 2021. Given the exploratory nature and the purpose of the research, university students were selected as the respondents. The national university where the pretest was conducted was again asked for assistance with the main survey. Lecturers at one of the faculties of this university helped distribute and collect the paper-based questionnaires, filled out by students who attended their classes during the survey weeks. The students were given time to check for information about *in vitro* meat using their mobile devices before giving answers to the questions. Participation was totally voluntary.

As a result, 468 questionnaires were collected. However, 75 of them were eliminated due to missing one or more answers. That created a usable sample of 393 respondents (83.97%), including 36 males and 351 females (six persons did not reveal their sex). This sample size was much larger than the threshold of 140 needed for a segmentation study with two criteria (Dolnicar, 2002). The reliability and validity of the segmentation analysis, therefore, were assumed.

Before the main analysis, Cronbach's alphas of the two segmentation criteria were calculated in IBM SPSS (International Business Machines Corporation's Statistical Package for the Social Sciences). Without deleting any items, the alphas were 0.80 for the ethical criteria and 0.85 for the personal criteria, respectively. The corrected item-total correlation values exceeded 0.40. Consequently, these two scales could be considered reliable (Morgan et al., 2004). In addition, the average

values of these scales were later used in the segmentation analysis.

The main analysis followed in two steps: hierarchical cluster analysis using Ward's method and *k*-mean cluster analysis (Burns and Burns, 2008). In the first step, the agglomeration coefficient values were referred to determine the number of clusters hidden in the sample. The changes in values between two consecutive steps of analysis suggested which number of clusters was meaningful enough to be accepted. According to the data presented in Table 1, a three-cluster solution and a four-cluster solution seemed to be suitable because two clusters might be too homogenous, while five clusters or more might be too heterogeneous.

Table 1. Calculation of the agglomeration coefficients.

| Number of clusters | Agglomeration coefficient of previous step | Agglomeration coefficient of this step | Change |
|--------------------|--|--|--------|
| 2 | 405.78 | 233.01 | 172.77 |
| 3 | 233.01 | 142.58 | 90.43 |
| 4 | 142.58 | 101.17 | 41.41 |
| 5 | 101.17 | 75.76 | 25.41 |
| 6 | 75.76 | 53.42 | 22.34 |
| 7 | 53.42 | 38.48 | 14.94 |
| 8 | 38.48 | 24.50 | 13.97 |
| 9 | 24.50 | 16.32 | 8.18 |
| 10 | 16.32 | 11.12 | 5.21 |

In the second step, both potential solutions were used for the computation. The outcomes showed that with both solutions, a very big cluster existed together with two to three smaller ones. With the four-cluster solution, the smaller ones included only 15, 37, and 78 members, respectively, which were too small to be appropriate. Therefore, the three-cluster solution was used for further

Table 2. Perception of *in vitro* meat.

| | Mean | Std. | Cluster 1 (n = 60) | Cluster 2 (n = 91) | Cluster 3 (n = 242) | F | <i>p</i> |
|--|------|------|--------------------|--------------------|---------------------|--------|----------|
| Ethical | 3.62 | 0.71 | 2.75 | 4.27 | 3.58 | 144.68 | 0.00 |
| <i>In vitro</i> meat will contribute to the preservation of natural resources. | 3.62 | 0.82 | 2.90 | 4.19 | 3.59 | 57.40 | 0.00 |
| <i>In vitro</i> meat will contribute to reduce the environmental impact of livestock. | 3.77 | 0.82 | 2.98 | 4.35 | 3.75 | 67.91 | 0.00 |
| <i>In vitro</i> meat will contribute to the protection of animal welfare. | 3.89 | 0.74 | 3.25 | 4.42 | 3.84 | 59.45 | 0.00 |
| <i>In vitro</i> meat will contribute to alleviating hunger in poor countries. | 3.49 | 0.87 | 2.72 | 4.13 | 3.44 | 64.27 | 0.00 |
| <i>In vitro</i> meat will be an effective alternative to the traditional meat production industry. | 3.28 | 0.91 | 2.37 | 3.99 | 3.25 | 80.70 | 0.00 |
| Personal | 2.98 | 0.73 | 1.98 | 3.93 | 2.86 | 465.11 | 0.00 |
| <i>In vitro</i> meat is as safe as natural meat. | 3.05 | 0.86 | 2.17 | 4.03 | 2.90 | 182.98 | 0.00 |
| <i>In vitro</i> meat is as nutritious as natural meat. | 2.95 | 0.89 | 2.03 | 3.89 | 2.83 | 151.46 | 0.00 |
| <i>In vitro</i> meat is as tasty as natural meat. | 2.98 | 0.84 | 2.07 | 3.88 | 2.86 | 165.06 | 0.00 |
| <i>In vitro</i> meat is as natural as natural meat. | 3.06 | 0.85 | 2.10 | 3.84 | 3.00 | 123.44 | 0.00 |
| <i>In vitro</i> meat is as cheap as natural meat. | 2.86 | 0.90 | 1.92 | 3.65 | 2.80 | 103.76 | 0.00 |

analysis. After the main analysis, an analysis of variance (ANOVA) was performed to distinguish the clusters from one another. Details about the three clusters are presented in the following section.

3. Results

Three clusters were identified as a result of the segmentation analysis (Tables 2, 3, 4). Overall, the clusters differed from one another in almost all criteria except for familiarity. The participants ate red meat, egg, poultry, and dairy products most often (mean values exceeded 2 out of 3 points). On the other hand, they consumed reptiles and insects, imitation meat, and nuts least regularly. Fish and other seafood were the only sources of protein that distinguished the three clusters, with members of cluster 2 eating more of this product than those of clusters 1 and 3.

The first cluster had 60 members who were doubtful about both the ethical and personal impacts of *in vitro* meat (Tables 2, 3, 4). Except for the protection of animal welfare (mean value $m = 3.25$), this cluster did not see much of a positive contribution to this novel meat. The members of this cluster were particularly concerned about the safety and price of this product ($m = 1.98$ and 1.92 , respectively). They also had weak emotional attachments with *in vitro* meat. The most positive sentiment people in this cluster had of this future food was a pleasant surprise ($m = 3.22$). On the other hand, the strongest negative feeling was worry ($m = 2.78$). Finally, this cluster's members were not confident sensation seekers, especially when considering their "thrill and adventure-seeking" and "disinhibition" traits. Considering these characteristics, this cluster was named "pessimists."

Table 3. Familiarity and attachment with *in vitro* meat.

| | Mean | Std. | Cluster 1 (n = 60) | Cluster 2 (n = 91) | Cluster 3 (n = 242) | F | p |
|----------------------|------|------|-----------------------|-----------------------|------------------------|-------|------|
| Familiarity | | | | | | | |
| Red meat | 2.71 | 0.46 | 2.70 | 2.69 | 2.72 | 0.13 | 0.88 |
| Poultry | 2.45 | 0.51 | 2.57 | 2.44 | 2.43 | 1.76 | 0.17 |
| Fish and seafood | 2.09 | 0.45 | 2.03 | 2.20 | 2.07 | 3.34 | 0.04 |
| Reptile and insect | 1.13 | 0.37 | 1.10 | 1.16 | 1.13 | 0.60 | 0.55 |
| Dairy | 2.40 | 0.53 | 2.35 | 2.48 | 2.38 | 1.53 | 0.22 |
| Eggs | 2.66 | 0.49 | 2.60 | 2.68 | 2.67 | 0.62 | 0.54 |
| Nuts | 1.98 | 0.42 | 1.92 | 1.97 | 2.00 | 0.87 | 0.42 |
| Beans | 2.18 | 0.53 | 2.12 | 2.18 | 2.19 | 0.51 | 0.60 |
| Mushrooms | 2.07 | 0.43 | 2.02 | 2.11 | 2.07 | 0.85 | 0.43 |
| Imitation meat | 1.58 | 0.54 | 1.50 | 1.67 | 1.57 | 1.95 | 0.14 |
| Attachment | | | | | | | |
| Contented | 3.25 | 0.71 | 2.63 | 3.84 | 3.19 | 74.41 | 0.00 |
| Energetic | 3.15 | 0.72 | 2.57 | 3.67 | 3.10 | 57.35 | 0.00 |
| Happy | 3.25 | 0.70 | 2.83 | 3.78 | 3.15 | 48.54 | 0.00 |
| Merry | 3.36 | 0.73 | 2.98 | 3.87 | 3.27 | 37.50 | 0.00 |
| Pleasantly surprised | 3.59 | 0.80 | 3.22 | 3.89 | 3.57 | 13.97 | 0.00 |
| Pleasant | 3.33 | 0.74 | 2.85 | 3.87 | 3.25 | 46.22 | 0.00 |
| Disappointed | 2.50 | 0.69 | 2.63 | 2.30 | 2.54 | 5.58 | 0.00 |
| Discontented | 2.34 | 0.71 | 2.48 | 2.11 | 2.39 | 6.74 | 0.00 |
| Disgusted | 2.26 | 0.76 | 2.38 | 1.98 | 2.33 | 8.30 | 0.00 |
| Dissatisfied | 2.51 | 0.77 | 2.57 | 2.24 | 2.60 | 7.33 | 0.00 |
| Distrustful | 2.73 | 0.85 | 2.67 | 2.40 | 2.86 | 10.81 | 0.00 |
| Fearful | 2.49 | 0.81 | 2.68 | 2.24 | 2.53 | 6.42 | 0.00 |
| Worried | 2.66 | 0.86 | 2.78 | 2.36 | 2.74 | 7.26 | 0.00 |

Table 4. Sensation seeking tendency.

| | Mean | Std. | Cluster 1 (n = 60) | Cluster 2 (n = 91) | Cluster 3 (n = 242) | F | p |
|--|------|------|-----------------------|-----------------------|------------------------|------|------|
| Experience seeking | | | | | | | |
| I would like to explore strange places. | 4.00 | 0.77 | 3.85 | 4.14 | 3.98 | 2.77 | 0.06 |
| I would like to take off on a trip with no pre-planned routes or timetables. | 3.56 | 1.00 | 3.45 | 3.88 | 3.46 | 6.32 | 0.00 |
| Boredom susceptibility | | | | | | | |
| I get restless when I spend too much time at home. | 3.51 | 1.01 | 3.25 | 3.56 | 3.55 | 2.32 | 0.10 |
| I prefer friends who are excitingly unpredictable. | 3.58 | 0.87 | 3.40 | 3.77 | 3.55 | 3.58 | 0.03 |
| Thrill and adventure seeking | | | | | | | |
| I like to do frightening things. | 3.12 | 0.98 | 2.85 | 3.45 | 3.07 | 8.08 | 0.00 |
| I would like to try bungee jumping. | 2.89 | 1.28 | 2.77 | 3.01 | 2.88 | 0.70 | 0.50 |
| Disinhibition | | | | | | | |
| I like wild parties. | 3.09 | 1.05 | 2.80 | 3.24 | 3.10 | 3.31 | 0.04 |
| I would love to have new and exciting experiences, even if they are illegal. | 2.05 | 1.00 | 1.82 | 2.38 | 1.98 | 7.45 | 0.00 |

The second cluster had 91 members who were more convinced about the potential contributions of *in vitro* meat from both ethical and personal perspectives (Table 2, 3, 4). The average evaluation of the ethical criteria was 4.27, and that of the personal criteria was 3.93. The members of this cluster also had strong emotional attachments with *in vitro* meat. The average value of the positive sentiments was 3.82. That of the negative

sentiments was 2.23. In addition, this cluster’s members had a stronger tendency to be sensation seekers, especially on the “experience seeking” and “boredom susceptibility” traits. The second cluster, therefore, was named “optimists.”

The third cluster had the largest number of members: n = 242 (Table 2, 3, 4). The members of this cluster saw

more ethical and personal impacts of *in vitro* meat than the pessimists, but less than did the optimists. Their attachments to this meat of the future were also stronger than those of the former but weaker than those of the latter. Moreover, these members were similar to either the pessimists (e.g., taking no pre-planned trips) or the optimists (e.g., participating in wild parties) regarding their sensation-seeking tendencies, depending on the particular traits. Based on this information, this cluster was named “mainstreamers.”

4. Discussion

The meat consumer market is not homogeneous. Based on consumer involvement with fresh meat consumption, a study in Belgium discovered four segments in the market: “straightforward,” “cautious,” “indifferent,” and “concerned” (Verbeke and Vackier, 2004). Considering consumers’ convenience orientation, another study in Spain identified four segments of lamb meat eaters: “traditional,” “uninvolved,” “adventurous,” and “careless” (Bernués et al., 2012). Similar to the Western markets, fresh meat buyers in Malaysia and Taiwan were both characterized by two distinct groups: “traditional market shoppers” and “modern store shoppers” (Hsu and Chang, 2002; Chamhuri and Batt, 2013). The findings of this study once again confirmed the diversity of the meat consumer market. Specifically, given customers’ perception of the ethical and personal impacts of *in vitro* meat products, the market was divided into a dominant segment of mainstreamers (61.58%) and two smaller segments of optimists (23.15%) and pessimists (15.27%). These market segments of *in vitro* meat, interestingly, are somewhat similar to those of other meat products mentioned previously (Verbeke and Vackier, 2004; Bernués et al., 2012).

The most likely potential customers of *in vitro* meat are certainly the optimists, who, at this time, account for approximately one-fourth of the whole meat consumer market. The least likely customers obviously are the pessimists, although their proportion was smaller than the other segments. These percentages are not much different from those in China (Zhang et al., 2020; Liu et al., 2021). Although the proportion may be regarded as small by many outsiders, this is a positive outlook since there are plenty of food products on the market (Bernstein et al., 2010), and *in vitro* meat is a product of the future and doubtlessly a controversial one that naturally some people are sceptical about (Goodwin and Shoulders, 2013; Laestadius and Caldwell, 2015). This result also shows that there is potential for *in vitro* meat in an Asian market (e.g., China and Vietnam), in addition to this in the West (Szejda et al., 2021).

4.1 Theoretical implications

Information familiarity can change customers’ perceptions of and behaviours toward meat products in positive ways (Fischer and Frewer, 2009; Verbeke et al., 2015; Bekker et al., 2017; Weinrich et al., 2020). In addition, experiential and cultural familiarity may also have a certain, yet limited, positive impact. Specifically, according to the findings of this study in Vietnam, the most optimistic customers of *in vitro* meat were those who ate fish and other seafood on a regular basis. Interestingly, both *in vitro* meat and fish or seafood can be regarded as consumable food products of flexitarians, those customers who are not on a strictly vegetarian or vegan diet (Hocquette, 2016; Hicks et al., 2018). The similarity and, thus, the familiarity of *in vitro* meat with fish and other seafood, in a sense, and with eaters of these products, in another sense, can be seen from this particular perspective. It should be noted that fish and seafood consumption is not only a personal habit but also a cultural custom of many Vietnamese people, given the long coastline and the existence of many rivers and ponds across the country (Lê, 1997).

In addition to familiarity, sensation-seeking tendencies might also affect customers’ perception of *in vitro* meat, similar to the findings of previous studies concerning other products (Fischer and Frewer, 2009). Specifically, with the Vietnamese participants surveyed for this study, the stronger this tendency was, the more positive the perception of *in vitro* meat was. This fact does not necessarily mean that these customers may have under-estimated the potential risks of *in vitro* meat (Lepp and Gibson, 2008). Instead, to properly understand the new product, they may want to find information about it and then try it or confront the potential risks attributed to it (Fuchs, 2013).

Finally, emotional attachment seems to have the strongest relationship with customers’ perceptions of *in vitro* meat (Weinrich et al., 2020). In the context of Vietnam, as partly demonstrated in this study, the more positive and less negative people’s feelings were, the less concerned they seemed to be about *in vitro* meat and vice versa. This point can be dually explained. In a sense, the positive perceptions might have led to positive sentiments (Baloglu and McCleary, 1999). In another sense, the positive feelings might have strengthened the positive perceptions and vice versa (Wilks et al., 2021). In both ways, the role of emotional attachment must be acknowledged and exploited to improve not only people’s cognitive perceptions but also their conative behavioural intentions (Read et al., 2011).

4.2 Practical implications

In vitro meat is a product of the future. At the present time, there are a variety of perceived risks and scepticisms attributed to this type of product (Goodwin and Shoulders, 2013; Laestadius and Caldwell, 2015). Despite these discouraging factors, there is already a segment of customers with positive perceptions (the optimists), both cognitive (perceived ethical and personal impacts) and affective (emotional attachments), of *in vitro* meat. To maintain and expand this segment of the population, producers and importers of *in vitro* meat should start informing potential customers about the benefits of *in vitro* meat, including those that are environmental, social, and personal. Once a positive impression is projected into the market, positive behavioural reactions from customers, such as their purchasing and eating such products, can be expected (Baloglu and McCleary, 1999; Read et al., 2011; Ellinda-Patra et al., 2020). In this regard, the “mainstreamers” customers may also be transformed and explored in the future.

The largest group of potential customers in this market (the optimists) is made up of those who have a strong tendency toward sensation-seeking. Some of these customers may naturally want to try *in vitro* meat as it is a novel product. Others may do the same in order to have more knowledge about it. The identification of this segment of customers is extremely vital for the development and commercialization of this product. Segmentation studies should, therefore, be continued in the future to assist the producers and importers of *in vitro* meat in this courageous undertaking. Research and development initiatives concerning *in vitro* meat, especially those implemented domestically in the involved country (Vietnam), can be considered to ensure the supply of this particular meat product in the next 10+ years.

4.3 Limitations and future directions

The observations of this study may be incomplete due to some limitations. First, by selecting a young university student population, this study bypassed the opinions of older and more experienced customers in Vietnam. As a result, the impact of personal and cultural familiarity might have been reduced, as the younger generation was probably not regular consumers of certain culture-oriented food products, such as reptiles, insects, and imitation meats (Looy et al., 2014). Second, since the sample mainly consisted of female respondents, the outcome was largely sex-biased. Nonetheless, female customers, as the major keepers of household kitchens (Vu, 2019), are an important player in the market. Their opinions, thus, have a certain level of representativeness.

Third, this study did not directly measure intentions to buy and eat *in vitro* meat since this product was not available in Vietnam’s market at the time of the research. In addition, the perception of the ethical and personal impacts, emotional attachments, and even the eating habits of people may change in the future. The referential value of this study, therefore, is not unlimited.

Considering these limitations, several directions for future research can be proposed. For example, a more diverse population, including people of different ages, biological sexes, and occupations, should be surveyed to define better the size of the most optimistic customers of *in vitro* meat segment. In addition, other factors that may affect the purchase and consumption of this new meat should be identified through qualitative attempts, such as through interviews and group discussions. The details gathered from these undertakings will provide more helpful information for the production and commercialization of *in vitro* meat in the future. Moreover, periodically repeating research on customers’ perceptions, behaviours, and characteristics is also necessary. Since all members of the consumer market as a whole cannot be treated as potential customers, only the most suitable segment should be targeted in order for profits to be maximized and risks to be minimized since the investments necessary to produce and promote *in vitro* meat will be large (Fountain, 2013; Lucas, 2020).

5. Conclusion

Despite the fact that *in vitro* meat is a future product, and thus its potential contributions to society, in general, and to each customer, in particular, are still controversial, and some people are concerned about it, there is already a proportion of the market in which customers have a good impression of this product. The inclinations of the people in this segment, to various degrees, are their familiarity with alternative protein-linked products, their emotional attachments to related products, and their tendency to be sensation-seeking individuals. Given time to prepare for the mass launch of *in vitro* meat in the years to come, producers and importers of this product are encouraged to provide accurate and persuasive information to these potential customers to gain their support and solidify their intentions.

Conflict of interest

The author declares no conflict of interest.

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