



Alternative proteins, evolving attitudes: Comparing consumer attitudes to plant-based and cultured meat in Belgium in two consecutive years

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ABSTRACT

Alternatives to conventional meat are considered an increasingly important tool in the drive to reduce consumption of animal products for environmental, public health and ethical reasons. We present two waves of a cross-sectional survey from a nationally representative sample in Belgium in 2019 ($n = 1001$) and 2020 ($n = 1000$). Participants answered questions online about their diets, attitudes towards existing plant-based meat alternatives, and attitudes towards cultured meat (grown from animal cells). We find that the proportion of Belgian consumers who said existing plant-based meat alternatives met their needs increased significantly from 44% in 2019 to 51% in 2020. We also find a significant increase in concern for issues related to animal agriculture, in particular the environment. We found no significant change in attitudes towards cultured meat between the two waves; in both 2019 and 2020, 39.3% of Belgian consumers said they would buy cultured meat. Regression analyses revealed that plant-based alternatives were more appealing to women and those with vegetarian diets, whilst cultured meat was more appealing to men. Overall, just 11.2% of consumers are both unsatisfied with existing meat alternatives and unwilling to buy cultured meat, while 43.2% of respondents were positive towards either plant-based or cultured meat, but not both, highlighting the need for a variety of alternative proteins in the market. Both cultured meat and plant-based meat were more appealing to younger consumers and those in the northern, predominantly Dutch-speaking region of Flanders. We discuss the implications of these findings for researchers and those seeking to strategically displace demand for animal products.

1. Introduction

Industrial animal farming is coming under increasing scrutiny for its impact on the environment, public health, and animal welfare. As well as contributing to 14.5% of greenhouse gas emissions (Gerber et al., 2013), rearing animals drastically increases demand for plants to feed them, expanding the total land requirements for food exponentially and contributing to significant deforestation around the world (Garcia, Ramos Filho, Mallmann, & Fonseca, 2017). Close contact with animals in agriculture also increases the risk of zoonotic diseases such as swine flu and bird flu (Klous, Huss, Heederik, & Coutinho, 2016; Taylor, Latham, & Woolhouse, 2001) and the rampant over-use of antibiotics in animal agriculture is accelerating the problem of antibiotic resistance in humans (Jia et al., 2017). Moreover, over 90% of farmed animals around the world live on factory farms where they suffer painful mutilations, small cages, and frequent abuse (Joy, 2020; Anthis, 2019).

If we are to avoid compounding the many pressing issues to which

industrial animal agriculture contributes, we must look to alternative forms of protein which can replicate the taste, convenience, and affordability of conventional animal products (Bryant, 2019). Although alternative proteins such as tofu, tempeh, and seitan have existed for some time, research suggests that meat-eaters tend not to find these products appealing (Doebel & Gabriel, 2015) and when they try them, often find them lacking in taste and other sensory attributes (Hoek et al., 2013). Modern plant-based meats (PBMs) process plant ingredients in innovative ways to more accurately emulate the product characteristics like taste and texture that are important to meat-eaters (Sayler, 2020).

The development and rapid improvement of PBMs has made avoiding animal products easier for vegetarians and vegans, but has also appealed to a growing consumer segment of 'flexitarians' (sometimes called 'reducetarians') (Kateman, 2017; Spencer, Cienfuegos, & Guinard, 2018). Increasingly, PBMs are cutting into the demand for meat from animals, leading to sales of some animal products falling like never before (Kart, 2020; Mintel, 2020; Webster, 2020). There is reason to

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think that the trend towards meat-free meals and PBMs has been accelerated by the COVID-19 pandemic. Eating more meals at home means that people have more freedom over what they eat, and some data appears to suggest that demand for PBMs (which are still more common in supermarkets than in restaurants) has indeed surged during this time (Nierenberg, 2020; Smithers, 2020).

Recent research has shown that PBM consumers are typically younger, mostly female, highly educated, and concerned about their health and the environment (Siegrist & Hartmann, 2019). That said, recent research has shown that PBMs are still generally perceived more negatively than conventional meat, with room for improvement in terms of taste, texture and price in many product categories (Michel, Hartmann, & Siegrist, 2020). However, some evidence suggests that PBMs tend to be more appealing to those lower in meat attachment, and thus relatively unappealing to meat-lovers (Bryant, Szejda, Deshpande, Parekh & Tse, 2019; Siegrist & Hartmann, 2019). Fortunately, a more appealing option exists for committed carnivores: cultured meat.

Cultured meat is real meat grown in vitro from animal cells (Post et al., 2020). Cells are taken from a living animal via a painless biopsy, and placed in a cultivator which provides them the nutrients and energy they need to replicate. These cells develop into muscle and fat tissue and are structured into meat products, thereby producing edible meat without animal slaughter. As well as sparing the animal, this meat production technique requires far fewer inputs in terms of water and land requirements, and produces far lower levels of greenhouse gas emissions compared to rearing animals (Tuomisto, 2019). In addition, producing meat in vitro allows us to circumvent the plethora of public health issues associated with industrial animal farming including the potential for zoonotic pandemics and rampant antibiotic abuse (Bryant, 2019).

In December 2020, cultured meat received its first regulatory approval by the Singapore Food Agency, and was sold to the public for the first time at a restaurant in Singapore (Kusmer, 2020). The technology has been seen by many as an important way to displace demand for animal meat, reduce industrial animal agriculture and alleviate the array of related problems (Post et al., 2020). The manifold benefits of such a transition towards cultured meat has inspired plenty of research on its public appeal (Bryant & Barnett, 2018, 2020). Research has indicated that, unlike PBMs, cultured meat tends to be more appealing to heavier meat eaters (Bryant, Szejda, Parekh, Deshpande, & Tse, 2019). While most consumers are open to trying cultured meat (Bryant, van Nek, & Rolland, 2020; Wilks & Phillips, 2017), some have concerns about its naturalness and safety, as well as more practical concerns around how it will taste and how expensive it will be (Lupton & Turner, 2018; Valente, Fiedler, Heidemann, & Molento, 2019). That said, all of this research was conducted in a pre-cultured meat world (Bryant & Barnett, 2020). It is possible that public perceptions around cultured meat will change quickly now that it is becoming available to the public – for example, Slade (2018) demonstrated that acceptance of cultured meat increased when participants were told that more other people were eating it.

Moreover, being comprised of animal ingredients at the cellular level means that cultured meat is more likely to be allowed by regulators to use ‘meat’ and related terms on its labelling compared to PBMs (Bryant, 2020), for which the use of such terms is an increasingly contested issue (Boffey, 2019; Flynn, 2019). This increased likeness to meat from animals may give cultured meat distinct advantages over other forms of alternative proteins (Bryant & Barnett, 2020). That said, a 2020 vote in the European Parliament affirmed that plant-based meat manufacturers are permitted to use meat-like terms in marketing their products, which may indicate regulators taking a more liberal view towards the marketing of alternative proteins.

The development of alternative proteins like cultured meat and PBMs is cause for optimism for those seeking to curtail industrial animal agriculture. However, while an increasing volume of literature has investigated consumer attitudes towards these products, a change in

these attitudes is yet to be tracked using two waves of a consistent survey. Bryant and Barnett (2018) speculated that cultured meat acceptance may increase over time since higher familiarity with the concept tends to be associated with higher rates of acceptance. Meanwhile, the quality and quantity of plant-based meats seems to have increased rapidly in recent years (Curtain & Grafenauer, 2019; Smithers, 2020).

Compared to other countries in Europe, Belgium has comparable rates of veganism, vegetarianism, pescetarianism and flexitarianism according to a recent survey by the vegan supermarket *Veganz* (2020). The survey of over 2600 people covered seven different countries, finding that Belgium had higher rates of meat-reducing diets than some countries including France and Denmark but not as high as other countries like Germany, Austria, and Switzerland. This position vis-à-vis meat reduction relative to other European countries is supported by other sources. The vegan app Happy Cow found that Belgium had 5.8 vegetarian restaurants per million inhabitants, somewhere between France (2.7 vegetarian restaurants per million inhabitants) and Germany (7.2 vegetarian restaurants per million inhabitants) (Zatat, 2016). As a country somewhere in the middle of the pack with respect to meat replacement, Belgium is likely to be reasonably comparable to other European countries on this topic. Moreover, containing multiple regions with different languages provides the opportunity for some comparison across cultures within the country.

This study, therefore, seeks to fill a gap in the literature by providing repeated cross-sectional survey data on consumer attitudes towards alternative proteins in two consecutive years. As well as attitudes towards plant-based meats and the top reasons consumers gave, this study explored consumer attitudes towards the as-yet-unavailable cultured meat. We examined how these attitudes changed over two survey waves one year apart, as well as descriptive and demographic data relating to these attitudes. Investigating the nature of these attitudes, especially whether and how they are changing over time, can give us some insight into the direction of protein consumption in the future. In particular, an improvement in attitudes towards meat alternatives over time would indicate that European consumers are generally away from eating meat and towards alternatives, and demonstrate that these alternatives are becoming more accepted over time. The implications of such a shift for the ethical, environmental, and public health issues affected by animal agriculture could be profound.

2. Methods

In order to address these questions, we conducted two waves of a cross-sectional survey in Belgium, the first in January 2019 and the second in June 2020. Data for this project was collected outside of an academic setting (by Ipsos on behalf of Global Action in the Interest of Animals (GAIA)), and therefore formal approval from an ethics board was not sought or granted. However, Ipsos data collection follows ESOMAR guidelines as standard (ESOMAR, 2011), including ensuring that participants give informed consent to take part and for their anonymised data to be published.

2.1. Procedure

Participants were invited to take part in an online survey. The survey was administered online using computer-assisted web interviewing (CAWI) via the Ipsos panel. The full survey instrument, including an English translation, is available at the OSF link: <https://osf.io/dvw64/>.

Participants first chose to answer the survey in either Dutch or French. They then answered screener questions to indicate their age, gender, and region so that representativeness could be achieved along these lines.

In the main questionnaire, participants first indicated their diet: meat eater, flexitarian, pescetarian, vegetarian, or vegan (descriptions for each diet were given). Next, participants were asked about the extent

to which the current range of meat substitutes met their needs (1 = not at all, 5 = fully), and participants who deviated from the central point on the scale were asked to select from a list the top three reasons why they felt current products did/not meet their needs. Next, participants were asked to indicate the extent they agreed that they consider different issues when purchasing products, including animal welfare, the impact on the environment, sustainability, and health (1 = strongly disagree, 5 = strongly agree).

Following this, participants were given the following description of cultured meat (translated here from Dutch/French): “*Scientists are currently working on a way to produce meat by using animal cells instead of live animals. This new method of meat production is likely to be available to consumers within the next five to ten years. Note that this type of meat is truly animal meat and should therefore not be confused with vegetable meat substitutes. This meat is therefore identical to animal meat (taste, nutritional value, ...) and does not need animals to be killed.*”

Participants then answered questions about cultured meat on a series of 5-point Likert scales, including first impressions (1 = very negative, 5 = very positive), relevance (1 = not at all relevant, 5 = extremely relevant), appeal (1 = very unappealing, 5 = very appealing), and purchase likelihood given price parity and price premiums of 10%, 25%, 50% and 100% (1 = definitely would not buy, 5 = definitely would buy). Participants also answered additional questions about the extent to which cultured meat would meet their needs (1 = not at all, 5 = completely), whether they would like to try it as soon as it becomes available (1 = definitely not, 5 = definitely yes), and how appealing they found the given name (‘kweekvlees’ in Dutch and ‘viande cultivée’ in French) (1 = very unappealing, 5 = very appealing).

Next, participants indicated the top three reasons they would be motivated to consume cultured meat, as well as the top three reasons they would be motivated not to consume cultured meat. Both were selected from given lists of possible concerns based on existing literature. Participants also indicated the projected impact of various guarantees on their attitudes towards cultured meat on a three-point scale (1 = Essential to me considering cultured meat, 2 = Would make me more likely to consider cultured meat, 3 = Not important to my decision about cultured meat). Guarantees included statements about animal suffering, environmental impact, risk of pathogens, antibiotic use, nutrition, price, taste, and regulation. Participants also indicated their opinion of whether cultured meat could be a solution to the problems of the meat industry today (1 = definitely not, 5 = definitely yes).

In the 2020 wave, additional questions were added at the end of the survey about the impact of COVID-19 on meat consumption and attitudes towards cultured meat. These questions did not produce comparisons over time, but may be informative nonetheless. Finally, participants answered socio-demographic questions including questions about their occupation, level of education, household size, and whether they were primarily responsible for family purchases.

2.2. Participants

Participants were recruited through Ipsos’ panel in Belgium. Participants were compensated for taking part in the study using a range of incentives and rewards used by Ipsos’ panel.

We used a different sample in 2019 (n = 1001) and 2020 (n = 1000) to avoid anchoring, though both samples were a good representation of the Belgian population. The samples were nationally representative in terms of their gender, age, and region, and samples were very similar in each wave (see Table 1).

As shown in Table 1, key demographics were comparable in the 2019 and 2020 waves.

Given very small differences in key demographics across the sample waves, we are confident that differences observed between the waves reflect changes in average attitudes over time rather than sampling bias.

Table 1
Demographics in the two waves.

Variable	2019	2020	Variable	2019	2020
Age (M, SD)	48.16 (15.70)	49.03 (16.89)	Education		
Gender			None	2.9%	3.5%
Male	49.2%	49.2%	Lower secondary, general	5.6%	5.7%
Female	50.8%	50.8%	Lower secondary, technical	6.7%	7.1%
Diet			Upper secondary, general	14.6%	13.7%
Omnivore	66.1%	62.2%	Upper secondary, technical	12.5%	12.9%
Flexitarian	31.4%	34.6%	Upper secondary, professional	7.3%	7.5%
Pescetarian	1.0%	1.3%	Bachelors degree	30.3%	31.4%
Vegetarian	1.3%	1.5%	Masters degree	18.9%	17.6%
Vegan	0.2%	0.4%	Doctorate	1.3%	0.6%
Region			Rural/Urban		
Brussels	10.5%	10.5%	Rural	46.2%	46.4%
Flanders	57.8%	57.6%	Urban	53.8%	53.6%
Walloon	31.7%	31.9%			

2.3. Materials

The survey instrument in the 2020 wave used the exact same question and answer wordings as the 2019 wave, although some questions were added in the 2020 wave. The full survey instrument for the more complete 2020 survey is available at the OSF project page (<https://osf.io/dvw64/>). Here, we highlight the key measures operationalized in the analysis (Table 2).

The questions were worded to capture specific concepts of interest in this study. Though these are not strictly validated measures, they are

Table 2
Key measures used in the analysis.

Measure	Question wording	Answer options
Satisfaction with existing alternatives	To what extent do you think the current range of meat substitutes meets your needs?	1. The current offer does not meet my needs at all 2. The current offer somewhat fails to meet my needs 3. The current offer neither meets, nor fails to meet my needs 4. The current offer somewhat meets my needs 5. The current offer fully meets my needs
Concern for related issues	When choosing products and services, I take into account ... (animal welfare; the impact on the environment; the sustainability of my choice; my health)	1. Totally disagree 2. Disagree 3. Neither agree nor disagree 4. Agree 5. Totally agree
Purchase intent for cultured meat	How likely are you to buy this type of meat if it is offered at the same price as meat today?	1. Definitely not 2. Probably not 3. Maybe yes, maybe not 4. Probably yes 5. Definitely yes
Cultured meat meets their needs	To what extent does this type of meat meet your needs in the context of alternatives to traditional meat (meat from slaughtered animals) ?	1. This meat does not meet my needs at all 2. This meat somewhat meets my needs 3. This meat neither meets, nor fails to meet my needs 4. This meat somewhat meets my needs 5. This meat totally meets my needs

similar to the 5-point Likert scales often used in similar research (e.g. Bryant & Barnett, 2019; Michel et al., 2020; Wilks & Phillips, 2017). The survey was available to participants in either Dutch or French, and translations were provided by Ipsos.

2.4. Analysis

We carried out a series of exploratory analyses to investigate changes in attitudes towards meat and related issues, satisfaction with existing PBMs, attitudes towards cultured meat, and how the two products may co-exist in the market.

First, with respect to attitudes towards meat and related issues, we used a chi square analysis to compare the prevalence of the different dietary categories between waves. We also used a series of independent samples *t*-tests to compare attitudes towards issues related to meat consumption between waves. In addition, we reported descriptive statistics relating to each of these questions.

Second, with respect to satisfaction with PBMs, we used an independent samples *t*-test to compare the extent to which PBMs met participants needs between waves. We also reported the percentage of participants who said that PBMs did (not) meet their needs who selected each reason for (against) eating PBMs. We then used a multivariate linear regression to identify demographic characteristics which predicted satisfaction with PBMs.

Third, with respect to attitudes towards cultured meat, we used an independent samples *t*-test to compare the proportion of people who said they would buy cultured meat between waves. We also reported the percentage of participants who selected each reason why they would and would not consume cultured meat. We then used a multivariate linear regression to identify demographic characteristics which predicted cultured meat purchase intent.

Finally, with respect to PBM and cultured meat co-existing, we conducted two types of simple descriptive analyses. Firstly, we segmented and cross-tabulated questions about the extent to which PBM and cultured meat met consumers needs in order to identify how the markets for these two products may overlap. Secondly, we reported the percentage of respondents in each of Belgium's three regions who said they would eat cultured meat, and who said that PBMs met their needs currently in order to identify the degree of geographical overlap.

3. Results

3.1. Attitudes towards meat and vegetarianism

As shown in Table 1 in the previous section, we did observe a small increase in meat-reducing diets in the 2020 wave compared to the 2019 wave. The proportion of omnivores fell by 3.9 percentage points, while all of the meat-reducing diets increased in prevalence. However, a chi square analysis indicates that this increase was not statistically significant ($\chi^2(4, N = 2001) = 3.998, p = 0.406$ | $V = 0.045$). Other differences between the samples in the two waves were very modest, and we are therefore confident in interpreting differences between the waves as changes over time rather than a result of sampling bias.

It is worth addressing that the rates of vegetarianism and veganism reported here are relatively low compared to other surveys in Belgium (EVA, 2019; Ipsos, 2018). This is likely because we were explicit in our definition of vegetarians and vegans that these categories included people who never eat meat or animal products. This likely resulted in a lower percentage of people identifying with these diets than might have otherwise, since we know that a high proportion of self-identifying vegetarians do in fact eat meat occasionally (Herzog, 2011). In this survey, these people were likely captured in the category 'flexitarian', which may not be offered in other surveys and in fact represents around a third of Belgian consumers in the sample.

We observed a modest increase in concern for issues related to animal agriculture. Concern for environmental impact showed a small but

statistically significant increases from 2019 to 2020, as shown in Table 3.

Overall, 54.3% said animal welfare was important to their food choices. 54.1% said the environment was important, while 58.4% said sustainability was important. 82% said their health was important.

3.2. Satisfaction with existing meat alternatives

We compared the average satisfaction with existing animal product alternatives in the 2019 wave against the 2020 wave using an independent samples *t*-test. This analysis showed an increase in satisfaction with existing meat alternatives between 2019 and 2020, and that this increase was statistically significant (see Table 4).

We also conducted this analysis on meat-eaters ($n = 1967$) and meat-avoiders ($n = 34$) separately. This analysis revealed that there was no significant increase in satisfaction with meat alternatives between waves for meat-avoiders ($t(32) = -1.439, p = 0.16$) but there was a significant increase in satisfaction with meat alternatives for meat-eaters ($t(1965) = -2.282, p = 0.023$).

Across both waves, for those who said meat substitutes did not meet their needs, taste was the most commonly selected barrier from the list (28.3%) followed by texture (18.5%) and healthiness (10.9%), as shown in Fig. 1. For those who said meat substitutes did meet their needs, product differentiation was the most commonly selected reason (20.7%), followed by animal welfare benefits (15.1%) and environmental benefits (10.1%) (Fig. 2). In both cases, the major benefits and barriers related to product quality.

We ran a multivariate linear regression to identify groups which tended to have the most positive perceptions of existing meat alternatives. Using satisfaction with existing alternatives as the dependent variable, we entered gender, age group, and dietary category as independent variables. Although the resulting regression model had a low R^2 value (0.041), the model overall was significant ($F(3,1997) = 28.696, p < 0.001$), and some of the predictor variables were also significant, as shown in Table 5.

The model indicates that there are significant differences in satisfaction with existing meat alternatives along some of these variables. Belonging to a younger age group, being female, and being vegetarian or vegan were all predictive of higher satisfaction with existing meat alternatives. Town size and level of education did not predict satisfaction. It is worth noting that the low R^2 value indicates that most groups were fairly even in their openness to meat alternatives, and the differences observed here were modest.

3.3. Attitudes towards cultured meat

The main part of the survey asked participants about their attitudes towards cultured meat. Overall, we found evidence for a substantial market for cultured meat in Belgium - in both the 2019 wave and the

Table 3
Concern for issues related to animal agriculture in 2019 and 2020.

Variable	2019	2020	T test	Effect Size	95% CI
Animal welfare	3.53 (0.91)	3.56 (0.90)	$t(1999) = 0.801, p = 0.423$	$d = 0.033$	-0.112–0.047
Environmental impact^a	3.46 (0.88)	3.54 (0.88)	$t(1999) = 1.971, p = 0.049$	$d = 0.091$	-0.112–0.047
Sustainability	3.56 (0.82)	3.59 (0.83)	$t(1999) = 0.832, p = 0.406$	$d = 0.036$	-0.103–0.042
Health	4.00 (0.73)	4.07 (0.75)	$t(1999) = 1.941, p = 0.052$	$d = 0.094$	-0.129–0.001

^a Indicates the difference between waves was significant at $p = 0.05$.

Table 4
Satisfaction with existing meat alternatives in 2019 and 2020.

Variable	2019	2020	Statistical test	Effect Size	95% CI
Satisfaction with existing meat alternatives ^a	3.16 (1.38)	3.31 (1.42)	t (1999) = 2.430, p = 0.015	d = 0.107	−0.275–0.029
Proportion answering in the affirmative ^a (existing substitutes somewhat or fully meet their needs)	44.0%	51.0%	χ^2 (1, N = 9,954, p = 0.002)	V = 0.071	OR = 1.113–1.582

^a Indicates the difference between waves was significant at p = 0.05.

2020 wave of the survey, 39.3% of participants said they would buy cultured meat if it was offered at the same price as conventional meat (see Table 6). A t-test indicated that there was no significant difference in purchase interest between the 2019 and 2020 waves (t (1999) = 0.267, p = 0.79). Further tests indicated that other attitudes towards cultured meat also showed no significant change between the 2019 and 2020 waves.

Participants also selected from a list the main factors which would encourage them to eat or to avoid cultured meat. Some answer options were added to the barriers in the 2020 wave: therefore, for clarity, we report here the proportion of people selecting each barrier/motivator as their main factor in the 2020 wave only. We note that the proportions were similar for other options between the 2019 and 2020 waves.

As shown in Fig. 3, the most commonly selected motivators were social goods: avoiding animal suffering, minimizing environmental impact, and providing food for the global poor. Personal benefits such as reducing exposure to diseases, avoiding additives/preservatives, and getting healthier meat were selected by relatively few respondents. This is in line with the weight of research which has found that consumers tend to identify the societal benefits of cultured meat far more readily than personal benefits (Bryant & Barnett, 2020).

As shown in Fig. 4, the most commonly cited single barrier was cost,

though other reasons such as not trusting cultured meat or finding it unnatural or otherwise inferior to conventional meat also ranked highly. A surprisingly high proportion of respondents selected one of the answer options newly added in the 2020 wave: that it will be made by multinational corporations. This answer ranked much higher than others which expressed a similar sentiment (i.e. that cultured meat is a commercial stunt, or that it might harm those in agricultural jobs). Although previous research has found that consumers rue the loss of the countryside and agricultural traditions which cultured meat could entail (Verbeke et al., 2015), this data shows that just 8.3% of respondents mentioned preserving traditions as an important reason to resist cultured meat.

Next, we examined the descriptive data from our other measures of cultured meat acceptance (Fig. 5) and consumers' willingness to pay a premium for cultured meat (Fig. 6).

As shown in Fig. 5, a large portion of consumers (around 40%) reported neutral reviews with respect to their first impressions, perceived relevance and appeal of cultured meat. Whilst more had positive views than negative views in terms of first impressions and appeal, the reverse was true for perceived relevance. This suggests that some consumers may recognize the benefits of cultured meat, but nonetheless feel it is not aimed at them. Indeed, this is consistent with previous literature, which has found that a higher number of people agreed with cultured meat in principle than said they would eat it personally in practice (Circus & Robison, 2019).

As shown in Fig. 6, some consumers reported being willing to pay a premium for cultured meat, though predictably, this portion was lower the higher the price premium. While almost a quarter of consumers said they would pay 10% more than the price of conventional meat, just over 5% said they would pay double the price. Initial cultured meat products are likely to be more expensive than conventional meat, but will also only be available in limited amounts (Bryant, 2020). As production expands, the cost will also fall, meaning that cheaper cultured meat will be available in higher quantities. This trajectory will likely fit well with limited demand at high prices, and increasing demand at lower prices which will occur over time.

Next, we ran a multivariate linear regression to identify groups which tended to have the strongest intention to purchase cultured meat.

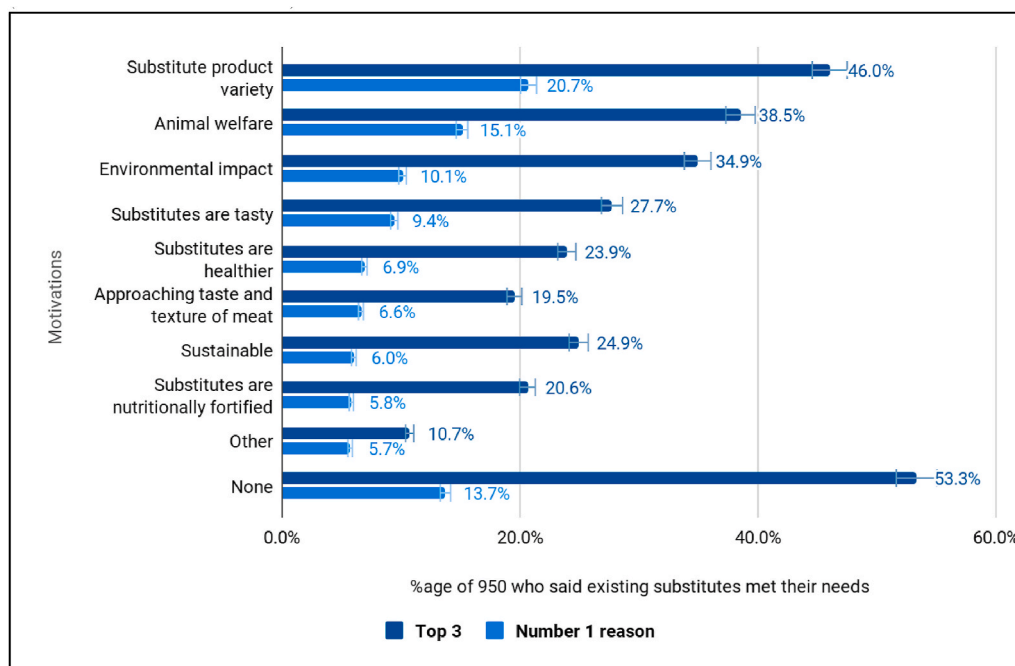


Fig. 1. The major reasons participants gave why existing meat alternatives met their needs (2019 and 2020 combined).

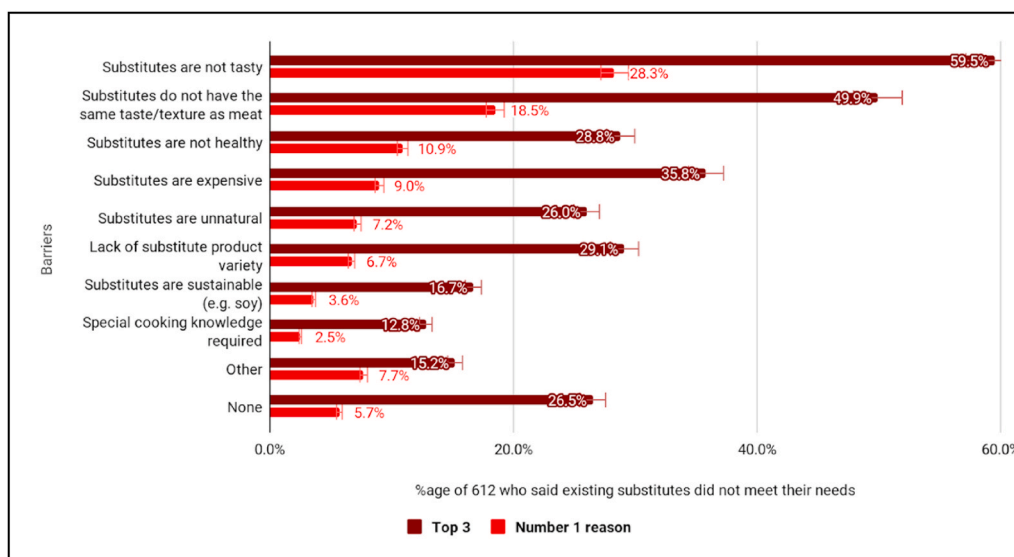


Fig. 2. The major reasons participants gave why existing meat alternatives did not meet their needs (2019 and 2020 combined).

Table 5

Factors predicting satisfaction with existing meat alternatives.

Variable	Unstandardized β	Standardized β	p
Constant	3.545		
Gender ^a	.138	.049	.026
Age Group ^a	-.309	-.177	<.001
Dietary Group ^a	.167	.074	.001
Urban town	-.032	-.011	.609
Education	-.014	-.020	.360

^a Indicates the variable was a significant predictor of satisfaction at $p = 0.05$.

Table 6

Cultured meat purchase intent in 2019 and 2020.

Variable	2019	2020	Statistical test	Effect Size	95% CI
Intention to purchase cultured meat	3.14 (1.38)	3.13 (1.42)	$t(1999) = 0.267, p = 0.79$	$d = 0.007$	$-0.088-0.116$
Proportion answering in the affirmative (probably or definitely would buy cultured meat)	39.3%	39.3%	$\chi^2(1, N = 2001) = 0, p = 1.000$	$V = 0.000$	$OR = 0.837-1.199$

Using cultured meat purchase intent as the dependent variable, we entered gender, age group, and dietary category as independent variables. Although the resulting regression model had a low R^2 value (0.013), the model overall was significant ($F(3,1997) = 8.620, p < 0.001$), and some of the predictor variables were also significant (see Table 7).

The model indicates that there are significant differences in cultured meat purchase intent along some of these variables. Again, belonging to a younger age group was predictive of more positive orientation, but unlike the above analysis for PBMs, this regression model showed higher purchase intent towards cultured meat amongst men. This is consistent with the majority of existing literature (Bryant & Barnett, 2020), and indicates that cultured meat may be able to appeal to sectors of the market who do not find PBMs appealing. Whilst PBMs were more appealing to those with more vegetarian diets, this model indicates that

dietary group did not significantly predict purchase intent with respect to cultured meat. Again, town size and education did not predict acceptance. It is worth noting that the low R^2 value indicates a fairly even openness to cultured meat across demographic groups, and differences identified here are modest.

3.4. The alternative protein market

The two regression models diverged substantially in the variables which predicted cultured meat and plant-based meat acceptance: plant-based meat was more appealing to females, whereas cultured meat was more appealing to males. Additionally, plant-based meat was more appealing to those following vegetarian diets, but this did not affect cultured meat acceptance. Some recent research from Arora, Brent, and Jaenicke (2020) has highlighted how different consumer groups prefer different protein sources, with some finding cultured meat more appealing and others preferring plant-based meat alternatives, legumes, or meat from animals. Therefore, we analysed how the total sample broke down in terms of a 3×3 grid showing those for whom cultured meat would, maybe would, or would not meet their needs, as well as those for whom plant-based meat does, maybe does, or does not meet their needs currently.

This was achieved using a simple cross-tabs analysis after recoding the relevant variables to be categorical (Yes/No/Maybe) for plant-based and cultured meat, producing a 3×3 table of responses. The total proportion of the sample in each group is shown in Table 8.

As we can see, the most populous segment (21.8%) is those who find that existing plant-based meat alternatives meet their needs, and also say that cultured meat would meet their needs. An additional 15.2% were satisfied with existing alternatives and said that cultured meat might meet their needs, while 10.3% are satisfied with existing alternatives, but said that cultured meat would not meet their needs. In terms of displacing demand for animal products, cultured meat companies can look to those consumers who are not satisfied with existing meat alternatives but would buy cultured meat (9.0%), those who are not satisfied with existing meat alternatives and might buy cultured meat (9.2%), and those who are positive about cultured meat but indifferent towards existing alternatives (7.0%). Just 12.1% of the population was said that both plant-based and cultured meat failed to meet their needs. Importantly, while 21.8% of consumers are positive towards both plant-based and cultured meat, a total of 41.5% are positive towards one or the other, but not both. This spread of responses across the different segments demonstrates the need for a variety of alternative proteins to

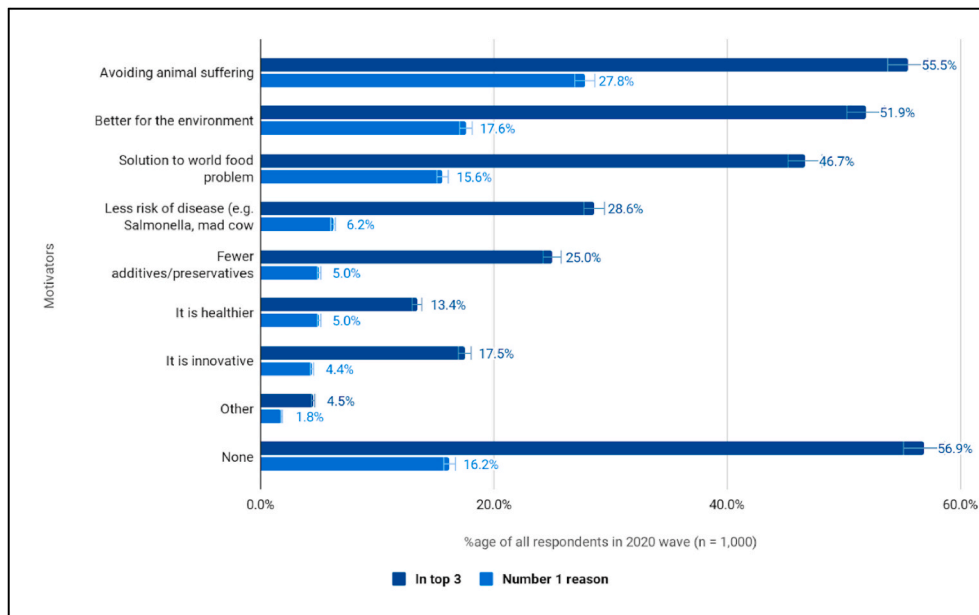


Fig. 3. Proportion of respondents who indicated each factor was their primary motivator to want to eat cultured meat.

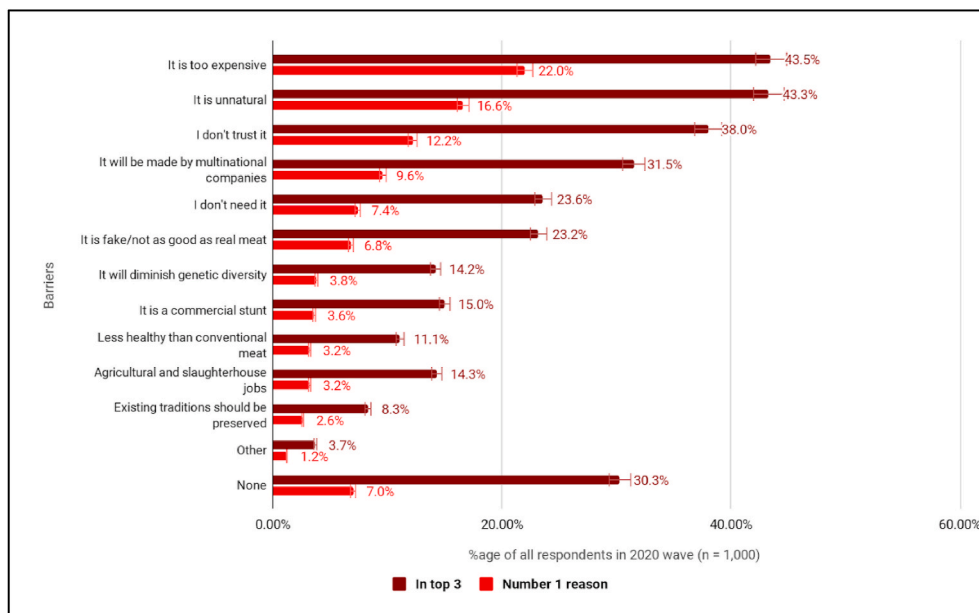


Fig. 4. Proportion of respondents who indicated each factor was their primary barrier to wanting to eat cultured meat.

appeal to different consumer groups (Arora et al., 2020; Bryant & Barnett, 2020).

Next, we used the demographic data to look at satisfaction with plant-based meats and purchase intent for cultured meat across the three main regions of Belgium (see Fig. 7). This includes data from both waves of the survey, and counts the proportion of participants who indicated affirmative answers on the positive end of scales (points 4 or 5 on 5-point Likert scales).

We can see from this analysis that respondents from Flanders were generally more positive with respect to both cultured meat and plant-based meat compared to the other regions. The difference was especially pronounced with respect to cultured meat acceptance, which was 10 percentage points higher in Flanders compared to Walloon. Given recent evidence for differing levels of cultured meat acceptance between European countries (Bryant et al., 2020), it is unsurprising that

significant regional variation exists within a country as culturally segmented as Belgium.

4. Discussion

The most important finding from this study was the significant increase in satisfaction with existing meat alternatives in Belgium between 2019 and 2020. The proportion of Belgian consumers satisfied with existing alternatives increased from 44% in 2019 to 51% in 2020. This likely reflects the increasing range and quality of meat alternatives, as well as increasing concern about related issues. In particular, concern for the environmental impact of food showed a small but significant increase from 2019 to 2020.

It is interesting to theorize about the relationship between satisfaction with meat alternatives and concern for issues relating to animal

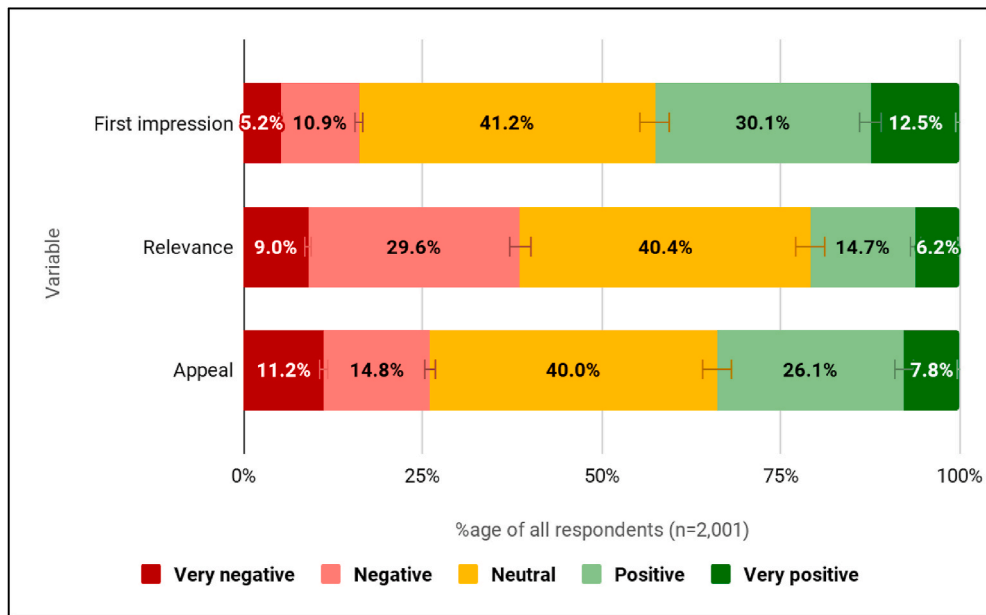


Fig. 5. First impressions, perceived relevance, and appeal of cultured meat (2019 and 2020 combined).

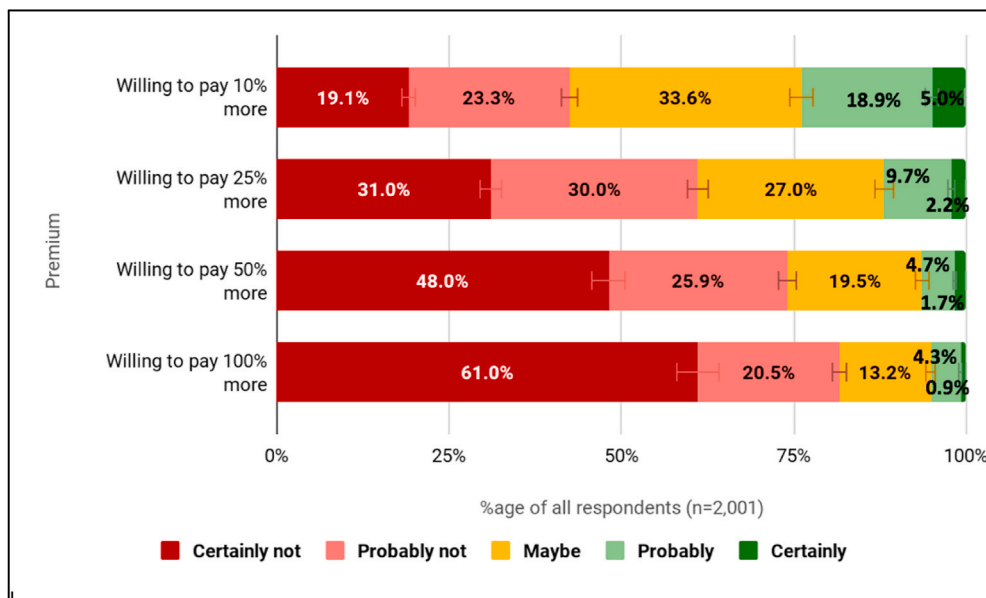


Fig. 6. Willingness to pay a premium for cultured meat (2019 and 2020 combined).

Table 7

Factors predicting purchase intent towards cultured meat.

	Unstandardized β	Standardized β	p
Constant	3.547		
Gender ^a	-.144	-.062	.006
Age Group ^a	-.134	-.092	<.001
Dietary Group	.024	.013	.567
Urban town	-.089	-.038	.086
Education	.019	.033	.139

^a Indicates the variable was a significant predictor of satisfaction at $p = 0.05$.

agriculture. Social psychologists have long framed meat consumption as an issue of motivated reasoning - most people do not want to stop eating meat, and they reach conclusions about related issues including animal suffering from that starting point (Rothgerber, 2020). If people are

Table 8

The proportion of the total sample with respect to cultured meat and plant-based meat.

Satisfaction with CM/PBM	CM would not meet their needs	CM maybe would meet their needs	CM would meet their needs	TOTAL
PBMs do not meet their needs	12.10%	9.20%	9.00%	30.30%
PBM maybe meets their needs	5.40%	9.40%	7.00%	21.80%
PBMs meet their needs	10.30%	15.20%	21.80%	47.30%
TOTAL	27.80%	33.80%	37.80%	99.40%

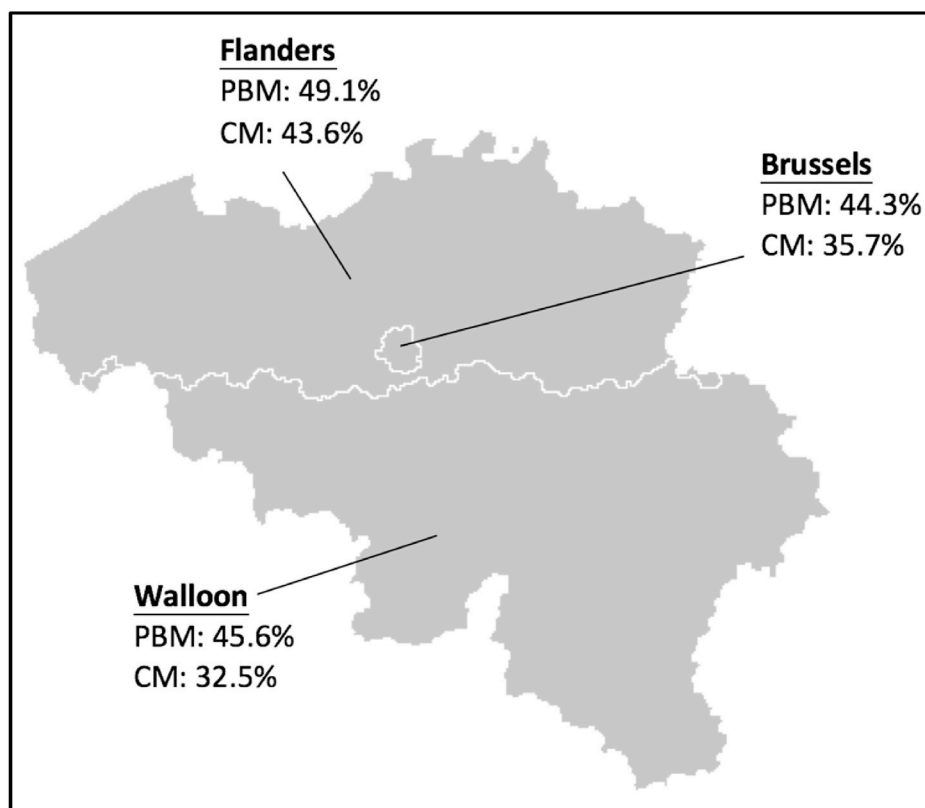


Fig. 7. Acceptance of plant-based and cultured meat in different regions of Belgium.

increasingly able to get the food they want from plant-based alternatives, the motivation to justify or overlook the many harms of industrial animal agriculture will presumably be greatly diminished. If this hypothesis is broadly correct, further data collection over time might expect to find an increase in concern for other issues such as animal welfare coming after an increase in satisfaction with meat alternatives. People will be psychologically free to develop a concern about animal welfare, since they will no longer need to defend meat consumption. In the absence of survey data over time on these issues, explaining the rise of animal product alternatives and changing attitudes towards animals would be a case of chicken and egg.

The prevalence of different motivators and barriers with respect to meat alternatives is indicative of a nascent industry where products are undergoing a period of rapid improvement and proliferation. Product variety was the most commonly selected reason why meat alternatives met consumers' needs - this was the only product-related benefit which was chosen more frequently than social benefits such as animal welfare and environmental impact, and indicates that Belgian consumers are pleased with the variety of products. However, those who said that meat substitutes did not meet their needs most often cited taste and texture as the main reasons. This may reflect the relatively recent rise of the market for meat alternatives, and a market with a large variety of small players offering products of varying quality (Elzerman, Hoek, van Boekel & Luining, 2011, 2015, p. 2015). Previous research has shown that a bad experience with meat alternatives can put would-be consumers off trying alternatives for a significant period of time (Elzerman, Hoek, Van Boekel, & Luining, 2011; Hartmann & Siegrist, 2017). While about half of Belgian consumers are satisfied with existing meat alternatives, half are not yet convinced, which indicates room for improvement for plant-based food manufacturers.

With respect to cultured meat, purchase intent and a range of related attitude measures showed no significant change between 2019 and 2020. Unlike plant-based alternatives, the market for which has truly evolved in that time, cultured meat is still unavailable to consumers so

broadly unchanged attitudes are to be expected over such a short period. It has been speculated that acceptance of cultured meat is likely to grow over time with increasing familiarity (Bryant & Barnett, 2018), which was not measured in this study. Although media coverage of cultured meat has been generally positive, it may not have been particularly prevalent during the period of this study, since it is likely to be driven by milestone events such as breakthroughs and product launches (Bryant, 2020; Bryant & Dillard, 2019). We can expect substantial changes in attitudes towards cultured meat when it becomes available to consumers.

The main reasons participants said they would consider cultured meat were societal benefits (for animals, the environment, and for world hunger). The barriers, on the other hand, were personal factors such as price, naturalness, healthiness, and trust. In particular, this study identified distrust of multinational companies as a potential issue for Belgian consumers - this reason ranked highly among alternatives, alongside the related issue of trust, and much higher than concern about agricultural jobs or being a commercial stunt. Some authors have written on the potential issue of power concentration in the food system under cultured meat production (Driessen & Korthals, 2012; Hocquette, 2016). Indeed, it seems feasible that such production systems will have higher (or at least different) barriers to entry for producers. Others have outlined visions for decentralized cultured meat production to ensure that food production remains distributed (Van der Weele & Driessen, 2013). This is an issue which food technology advocates should take seriously. Although previous studies in Europe have identified tradition as a barrier to cultured meat adoption, this was in fact the least often selected barrier in this study.

We also demonstrated the need for multiple approaches with respect to alternative proteins. Almost half of respondents indicated a positive attitude towards either cultured or plant-based meat, but not both. This is in line with the findings of Arora et al. (2020) who demonstrated that similar consumer segments existed who preferred different protein sources in their Mumbai sample. In particular, our regression analyses

showed that cultured meat is more likely to be more appealing to men, while existing plant-based alternatives are more appealing to women and those inclined towards vegetarian diets, while both types of alternative protein are more appealing to younger consumers. These differences are in line with existing research on plant-based and cultured meat (Bryant et al., 2019; Hoek et al., 2011). Different protein alternatives can therefore helpfully co-exist catering to different sectors of the alternative protein market.

While some differences existed between these segments, cultured meat and plant-based alternatives were both more appealing to younger consumers, and to those in the Flanders region of Belgium. Previous research has agreed that these novel products are generally more preferred by younger consumers (Bryant & Barnett, 2020; De Boer & Aiking, 2011; Hoek et al., 2011). Meanwhile, cross-country data has shown that cultured meat in particular tends to be more appealing to those in the Netherlands compared to other European countries (Grasso, Hung, Olthof, Verbeke, & Brouwer, 2019), and more appealing to Germans than the French (Bryant et al., 2020). Both of these differences might have suggested that we would observe such a regional variation within Belgium - the predominantly Dutch-speaking Flanders is likely closer in culture to the Netherlands, whereas the predominantly French-speaking Walloon may have more in common with France.

There are some limitations to acknowledge in this study. First, participants recruited from Ipsos' panel were taken at random from a larger sample for each wave, and there is a chance some participants were included in both waves. While this does not invalidate the study, it is preferable for surveys over time to either observe the same group over time (to observe individual changes) or to use a different cross-section for each wave. Participants who took the survey twice may have had more information or been anchored to their previous answers, though given that over a year had elapsed between waves, this concern is not substantial. Second, the addition of some questions or answer options in the second wave meant that some data is not comparable between waves - for example, the addition of two potential barriers to cultured meat consumption in the 2020 wave meant that we only reported 2020 data for these questions. Relatedly, when asking about potential concerns/benefits using a multiple choice list as opposed to text entry, one cannot rule out the possibility that participants give reasons from the list which they would not have thought of themselves.

Furthermore, participants were not asked about their direct experience with meat substitutes, meaning that answers to this question could not be interpreted in detail. That said, there is no reason to think that participants in one wave would have interpreted this question differently from participants in the other wave, and therefore the comparison between waves is still fair, if lacking in detail. Moreover, the lack of standardized validated measures means that there is some uncertainty as to whether questions were interpreted the same in Dutch and French. Finally, this study was limited geographically to Belgium, and though alternative protein trends here appear comparable to those in neighboring European countries, we cannot be certain of the extent to which these findings are generalizable to other cultures.

Overall, this study indicates a small but significant increase in satisfaction with meat alternatives, and a significant increase in concern for food's environmental impact. Future research should build on this exploratory study with confirmatory research. In particular, research should continue to monitor changes in these opinions: research over time may provide evidence that changes in attitudes towards animals resulted from improved alternatives, and not the other way around (e.g. Loughnan, Bastian & Haslan, 2010). Additionally, future work might ask about specific animal product alternative categories (e.g. burgers, nuggets, cheese) to build a more detailed picture of which products are improving and which have room for development.

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Ethical statement

Data for this study was collected by Ipsos in line with ESOMAR guidelines: https://www.esomar.org/uploads/public/knowledge-and-standards/codes-and-guidelines/ESOMAR_Guideline-for-online-research.pdf.

References

- Arora, R. S., Brent, D. A., & Jaenicke, E. C. (2020). Is India ready for alt-meat? Preferences and willingness to pay for meat alternatives. *Sustainability*, 12(11), 4377.
- Boffey, D. (2019, April 04). 'Veggie discs' to replace veggie burgers in EU crackdown on food labels. The Guardian. Available online: <https://www.theguardian.com/food/2019/apr/04/eu-to-ban-non-meat-product-labels-veggie-burgers-and-vegan-steaks> Accessed 27 July 2020.
- Bryant, C. (2019). We can't keep meat like this: Attitudes towards vegetarian and vegan diets in the United Kingdom. *Sustainability*, 11(23), 6844.
- Bryant, C. (2020). Culture, meat, and cultured meat. *Journal of Animal Science*.
- Bryant, C., & Barnett, J. (2018). Consumer acceptance of cultured meat: A systematic review. *Meat Science*, 143, 8–17.
- Bryant, C., & Barnett, J. (2020). Consumer acceptance of cultured meat: An updated review. *Applied Sciences*, 10(15), 5201.
- Bryant, C., & Dillard, C. (2019). The impact of framing on acceptance of cultured meat. *Frontiers in Nutrition*, 6, 103.
- Bryant, C., Szejda, K., Parekh, N., Desphande, V., & Tse, B. (2019). A survey of consumer perceptions of plant-based and clean meat in the USA, India, and China. *Frontiers in Sustainable Food Systems*, 3, 11.
- Bryant, C., van Nek, L., & Rolland, N. (2020). European markets for cultured meat: A comparison of Germany and France. *Foods*, 9(9), 1152.
- Circus, V. E., & Robison, R. (2019). Exploring perceptions of sustainable proteins and meat attachment. *British Food Journal*.
- Curtain, F., & Grafenauer, S. (2019). Plant-based meat substitutes in the flexitarian age: An audit of products on supermarket shelves. *Nutrients*, 11(11), 2603.
- De Boer, J., & Aiking, H. (2011). On the merits of plant-based proteins for global food security: Marrying macro and micro perspectives. *Ecological Economics*, 70(7), 1259–1265.
- Doebel, S., & Gabriel, S. (2015, January 24). Which vegan meals do omnivores find most appetizing and accessible? Humane league labs. Available online: <http://www.humaneleague.org/static/reports/2015/01/appetizing-vegan-food-photos-study-results1.pdf> accessed on 28 July 2020.
- Drissen, C., & Korthals, M. (2012). Pig tears and in vitro meat: Disclosing moral worlds by design. *Social Studies of Science*, 42(6), 797–820.
- Elzerman, J. E., Hoek, A. C., Van Boekel, M. A., & Luning, P. A. (2011). Consumer acceptance and appropriateness of meat substitutes in a meal context. *Food Quality and Preference*, 22(3), 233–240.
- Elzerman, J. E., Hoek, A. C., van Boekel, M. J., & Luning, P. A. (2015). Appropriateness, acceptance and sensory preferences based on visual information: A web-based survey on meat substitutes in a meal context. *Food Quality and Preference*, 42, 56–65.
- Esomar. (2011). ESOMAR guideline for online research. Available at: https://www.esomar.org/uploads/public/knowledge-and-standards/codes-and-guidelines/ESOMAR_Guideline-for-online-research.pdf.
- Eva. (2019, February 13). Almost half of Belgians have reduced their meat consumption in the past year. Available at: <https://www.evavzw.be/nieuws/bijna-helft-van-de-belgen-heeft-zijn-vleesconsumptie-het-laatste-jaar-verminderd>.
- Flynn, D. (2019 April 03). 3 states join contested Missouri ban on using "meat" on cell cultured product labels. *Food Safety News*. Available online: <https://www.foodsafetynews.com/2019/04/3-states-join-contested-missouri-ban-on-using-meat-on-cell-cultured-product-labels/> Accessed 28 July 2020.
- Garcia, E., Ramos Filho, F. S. V., Mallmann, G. M., & Fonseca, F. (2017). Costs, benefits and challenges of sustainable livestock intensification in a major deforestation frontier in the Brazilian Amazon. *Sustainability*, 9(1), 158.
- Gerber, P. J., Steinfeld, H., Henderson, B., Mottet, A., Opio, C., Dijkman, J., & Tempio, G. (2013). Tackling climate change through livestock: A global assessment of emissions and mitigation opportunities. Food and Agriculture Organization of the United Nations (FAO).
- Grasso, A. C., Hung, Y., Olthof, M. R., Verbeke, W., & Brouwer, I. A. (2019). Older consumers' readiness to accept alternative, more sustainable protein sources in the European Union. *Nutrients*, 11(8), 1904.
- Hartmann, C., & Siegrist, M. (2017). Consumer perception and behaviour regarding sustainable protein consumption: A systematic review. *Trends in Food Science & Technology*, 61, 11–25.
- Herzog, H. (2011). September 06). Why are there so few vegetarians? Psychology today. Available at: <https://www.psychologytoday.com/gb/blog/animals-and-us/201109/why-are-there-so-few-vegetarians>.
- Hocquette, J. F. (2016). Is in vitro meat the solution for the future? *Meat Science*, 120, 167–176.
- Hoek, A. C., Elzerman, J. E., Hageman, R., Kok, F. J., Luning, P. A., & de Graaf, C. (2013). Are meat substitutes liked better over time? A repeated in-home use test with meat substitutes or meat in meals. *Food Quality and Preference*, 28(1), 253–263.

- Hoek, A. C., Luning, P. A., Weijzen, P., Engels, W., Kok, F. J., & De Graaf, C. (2011). Replacement of meat by meat substitutes. A survey on person-and product-related factors in consumer acceptance. *Appetite*, 56(3), 662–673.
- Ipsos. (2018). Global views on food - 2018. Available at: https://www.ipsos.com/site/s/default/files/ct/news/documents/2018-12/ipsos_global_advisor_views_on_food_2018.pdf.
- Jia, S., Zhang, X. X., Miao, Y., Zhao, Y., Ye, L., Li, B., et al. (2017). Fate of antibiotic resistance genes and their associations with bacterial community in livestock breeding wastewater and its receiving river water. *Water Research*, 124, 259–268.
- Joy, M. (2020). Why we love dogs, eat pigs, and wear cows: An introduction to carnism. *Red Wheel*.
- Kart, J. (2020, July 17). People buying more alternative meat, expected to consume less real meat through 2025. *Forbes*. Available online: <https://www.forbes.com/sites/jeffkart/2020/07/17/people-buying-more-alternative-meat-expected-to-consume-less-real-meat-through-2025/?sh=78b392251a06>.
- Kateman, B. (2017). *The reductarian solution: How the surprisingly simple act of reducing the amount of meat in your diet can transform your health and the planet*. Penguin.
- Anthis, Kelly, & Sentience Institute. (2019). *Global Farmed Factory Farmed Animals Estimates*. Available online: <https://www.sentienceinstitute.org/global-animal-farming-estimates>.
- Klous, G., Huss, A., Heederik, D. J., & Coutinho, R. A. (2016). Human–livestock contacts and their relationship to transmission of zoonotic pathogens, a systematic review of literature. *One Health*, 2, 65–76.
- Loughnan, S., Haslam, N., & Bastian, B. (2010). The role of meat consumption in the denial of moral status and mind to meat animals. *Appetite*, 55(1), 156–159.
- Lupton, D., & Turner, B. (2018). Food of the future? Consumer responses to the idea of 3D-printed meat and insect-based foods. *Food and Foodways*, 26(4), 269–289.
- Michel, F., Hartmann, C., & Siegrist, M. (2020). Consumers' associations, perceptions and acceptance of meat and plant-based meat alternatives. *Food Quality and Preference*, 87, 104063.
- Mintel. (2020, January 17). *Plant-based push: UK sales of meat-free foods shoot up 40% between 2014-19*. Mintel. Available online: <https://www.mintel.com/press-centre/food-and-drink/plant-based-push-uk-sales-of-meat-free-foods-shoot-up-40-between-2014-19>.
- Nierenberg, A. (2020, May 22). *Plant-based 'meats' catch on in the pandemic*. New York Times. Available online: <https://www.nytimes.com/2020/05/22/dining/plant-based-meats-coronavirus.html>.
- Post, M. J., Levenberg, S., Kaplan, D. L., Genovese, N., Fu, J., Bryant, C. J., & Moutsatsou, P. (2020). Scientific, sustainability and regulatory challenges of cultured meat. *Nature Food*, 1(7), 403–415.
- Rothgerber, H. (2020). Meat-related cognitive dissonance: A conceptual framework for understanding how meat eaters reduce negative arousal from eating animals. *Appetite*, 146, 104511.
- Saylor, Z. (2020). March 30). *Is fake meat getting too much like the real thing?* The guardian. Available online: <https://www.theguardian.com/us-news/2020/mar/29/fake-meat-vegetarian-impossible-burger-cell-based> Accessed 30 July 2020.
- Siegrist, M., & Hartmann, C. (2019). Impact of sustainability perception on consumption of organic meat and meat substitutes. *Appetite*, 132, 196–202.
- Slade, P. (2018). If you build it, will they eat it? Consumer preferences for plant-based and cultured meat burgers. *Appetite*, 125, 428–437.
- Smithers, R. (2020, July 25). UK demand for new vegan food products soars in lockdown. <https://www.theguardian.com/lifeandstyle/2020/jul/25/uk-demand-for-new-vegan-food-products-soars-in-lockdown>.
- Spencer, M., Cienfuegos, C., & Guinard, J. X. (2018). The Flexitarian Flip™ in university dining venues: Student and adult consumer acceptance of mixed dishes in which animal protein has been partially replaced with plant protein. *Food Quality and Preference*, 68, 50–63.
- Taylor, L. H., Latham, S. M., & Woolhouse, M. E. (2001). Risk factors for human disease emergence. *Philosophical Transactions of the Royal Society of London - Series B: Biological Sciences*, 356(1411), 983–989.
- Tuomisto, H. L. (2019). The eco-friendly burger: Could cultured meat improve the environmental sustainability of meat products? *EMBO Reports*, 20(1), Article e47395.
- Valente, J. D. P. S., Fiedler, R. A., Sucha Heidemann, M., & Molento, C. F. M. (2019). First glimpse on attitudes of highly educated consumers towards cell-based meat and related issues in Brazil. *PLoS One*, 14(8), Article e0221129.
- Van der Weele, C., & Driessen, C. (2013). Emerging profiles for cultured meat; ethics through and as design. *Animals*, 3(3), 647–662.
- Veganz. (2020). Veganz nutrition study 2020. Available online: <https://vegan-nutrition-study-2020/>.
- Verbeke, W., Marcu, A., Rutsaert, P., Gaspar, R., Seibt, B., Fletcher, D., et al. (2015). 'Would you eat cultured meat?': Consumers' reactions and attitude formation in Belgium, Portugal and the United Kingdom. *Meat Science*, 102, 49–58.
- Webster, B. (2020). January 02). *Sales of beef and pork plunge as Britons choose vegan diet*. The Times. Available online: <https://www.thetimes.co.uk/article/red-meat-sales-hit-as-800-000-people-go-vegetarian-kpz2k3xnz>.
- Wilks, M., & Phillips, C. J. (2017). Attitudes to in vitro meat: A survey of potential consumers in the United States. *PLoS One*, 12(2), Article e0171904.
- Zatari, N. (2016, October 04). A map of most vegetarian friendly countries in Europe. *The Independent*. Available online: <https://www.indy100.com/news/a-map-of-most-vegetarian-friendly-countries-in-europe-7344711>.