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Enabling sustainable plant-forward transition: European consumer attitudes and intention to buy hybrid products

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A B S T R A C T

Although recommendations for a transition towards more plant-forward diets have been proposed and despite consumers reporting willingness to reduce meat consumption, consumer behaviour is frequently less environmentally sustainable than recommended. This calls for simpler strategies that may lead to a more optimistic view on both supply and demand side by using less rigid and more flexible approaches, such as hybrid products, combining meat and plant-based ingredients. Against this milieu, present study examines for the first-time in a cross-cultural context (Denmark, Spain, UK) and on a large consumer sample (N = 2766), attitudes and intention to buy hybrid products, while taking into account consumers individual traits related to meat attachment, health consciousness and environmental self-identity. Results show that hybrid products could be a crucial driver for enabling a successful plant-forward transition, as the meat element in these products, together with consumers' affinity and pleasure-seeking attitudes towards meat, would facilitate consumers' acceptance of more sustainable alternatives. Indeed, our results show that sensory perceptions play a major role in mediating the effect of consumers' attitudes on intention to buy hybrid products. Conversely, consumers' environmental self-identity and health consciousness have minimal to no effect on consumers' attitudes towards hybrid products. Thus, the results of our study support the value of strategies centring on bringing the best of two worlds: the pleasurable sensory characteristics of the meat realm, and the healthiness and sustainability benefits of the plant realm. In this sense, hybrid products could be an elegant initial approach adopted by practitioners and supported by policy makers to enable a more nuanced transition from fully meat-based to plant-forward diets.

1. Introduction

The sustainability of the meat sector is challenged with growing population, increasing purchase power, and its direct and indirect influence on environment and public health (Pais, Marques, & Fuinhas, 2020). Despite the latest stagnation in meat consumption patterns, Europe has recorded the highest ever level of meat per capita consumption, almost two times the world average (FAO, 2021). Further, it is expected that the increase in population and income will further lead to a higher shift towards meat consumption (Godfray et al., 2018; Sans & Combris, 2015). Although flexitarian, vegetarian, and vegan trends have been observed (Spencer & Guinard, 2018), meat seems to be a preferred option for many consumers due to its tradition, nutritional value, convenience, and affordability (Allievi, Vinnari, & Luukkanen, 2015), and many consumers do have a strong attachment to meat (Graça, Calheiros,

& Oliveira, 2015). According to recent European surveys, although roughly 40% of consumers have intention to stop eating or cut down on red meat consumption they still prioritize taste, food safety, and price over sustainability concerns (BEUC, 2020; EC, 2020b), opposing ambitious aims of the Farm to Fork Strategy on creating a sustainable food system (EC, 2020a).

This trend in demand for meat is of importance and urgent concern for several reasons. Meat consumption, and red meat consumption in particular, has often been associated to a higher risk of non-communicable diseases (NCDs), such as cardiovascular disease, cancer, and diabetes (Godfray et al., 2018), while reduction of meat and more plant-based diet is often suggested (de Boer & Aiking, 2020). On the other hand, unlike plant proteins, meat is an excellent source of nutrients such as phosphorus and zinc, while having complete protein with a good balance of all necessary amino acids (Bohrer, 2017).

Nonetheless, livestock production is a major contributor to the environmental pressure through land occupation, water use, and greenhouse gas (GHG) emissions (Pais et al., 2020). Due to the meat production and demand complexity, calls have been made towards reduction of such agriculture practices, seen as an obstacle to the achievement of sustainability goals (EC, 2020a). This is particularly challenging as meat and livestock production contribute substantially to the European economy, making up 45% of the European agricultural production value (Breuer, Martin, Wierig, & Saggau, 2019). Furthermore, it has been suggested that a reduction in meat consumption would severely distress and impose complex challenges for the EU livestock industry, and in particular the beef sector (Santini, Ronzon, Perez Dominguez, Araujo Enciso, & Proietti, 2017).

Given the cornucopia of environmental and health effects of meat consumption, as well as the effect the reduction of red meat would have on the economy, together with the apparent clash of consumers' sympathy for meat reduction and the attachment to meat, it is surprising that policy makers demonstrate little interest in less black and white strategies which could alleviate the transition towards more sustainable eating practices. The recognition of more courses of actions towards a plant-forward diet entails that the debate around meat should not only include "rigid" sustainable consumption and strategies. Such a narrow focus simply restricts the consideration of sustainability and produces frustration about the support from consumers and industry actors. More flexible approaches involving simple strategies as producing "less but better" and "less but varied" (Pais et al., 2020) would lead to a more optimistic view on both the supply and demand side. Considering that reduction of meat consumption is necessary (EC, 2020a), the meat sector, confronted with this imminent dilemma of transforming or die trying, should adapt its approach to these new market signals. Here, simple strategies that could help the supply, as well as the demand side, could be as down-to-earth as substituting *part* of the meat with plant-based ingredients, and introducing hybrid products. These could lead to both reduction in meat production and consumption indorsing healthier and more sustainable dietary habits, while preserving the livestock industry and the environment. This is especially important in the light of the enormous pressure the meat sector is already facing in providing more choices and value-added solutions that are healthy and/ or more environmentally friendly, while at the same time gaining consumer support (Otto, Strenger, Maier-Nöth, & Schmid, 2021; Pais et al., 2020).

1.1. Hybrid products definition, benefits and barriers

Recently, new food hybrid products have been launched in the European and the US market that make it possible to supplement consumer meat or dairy intake with plant-based ingredients. Examples of these hybrid products are Danish Crowns' 50′/50′ concept burgers, UK Applegate's Well-Carved beef and veggie burger and Beyond Meat burgers, but also Dairy Farmers of America's lactose-free milks featuring 50:50 blends of plant-based milk and cow's milk in the US, offered both in the supermarkets and restaurants (Fortune, 2019; Southey, 2021; Watson, 2020). Hybrid products are thus largely defined as products that possess attributes of more than one product category. As hybrid products possess attributes of more than one product category, consumers might potentially assign them to different product categories (Rajagopal & Burnkrant, 2009). This could be a challenge for hybrid products as consumers might assign them to a single pre-existing product category based on its ingredients it or how well it resembles the prototype of a particular product category (Gregan-Paxton, Hoeffler, & Zhao, 2005). This affinity could initially reduce the appeal of a hybrid product, as it competes with other products that are more prototypical (e.g. fully meat-based products), but on the other hand could also resonate with some consumers who would like to decrease the consumption of meat. Therefore, the understanding of the above could help retailers and manufacturers of existing hybrid products to build suitable

displays and settings that could appeal to the specific consumer's traits such that consumers could swiftly form favourable attitudes towards hybrid products.

Based on the above, the hybrid products involving meat (as burgers) are defined as products where part of the meat is replaced with other more sustainable plant-based sources such as vegetables and legumes (Barone et al., 2021; Grasso & Jaworska, 2020; Neville, Tarrega, Hewson, & Foster, 2017; Tarrega, Rizo, Murciano, Laguna, & Fiszman, 2020). These hybrid products could be produced in different ways, depending on the utilized meat and plant-based ingredients, thus varying in shape and nutritional value (Neville et al., 2017). In the broader sense, hybrid products can also be seen as a meat substitute, since they replace part of the meat (Neville et al., 2017). In this sense, some of the factors that affect acceptance of the meat substitutes might be similar to those affecting hybrid products. For instance, prior research has shown that meat attachment, intended as the positive bond towards meat consumption, is a significant predictor of consumers' willingness to consume plant-based alternatives (Circus & Robison, 2019; Graça et al., 2015). In particular, meat attachment entails consumers' *affinity* towards meat consumption and the view of meat as a source of pleasure (i. e., *hedonism*), but also consumers' feelings of *entitlement* towards and *dependence* on meat consumption. This reflects the strong centrality of meat consumption in Western diets (Spencer, Kurzer, Cienfuegos, & Guinard, 2018), which translates in consumers developing an affective connection towards meat and in their subsequent reluctance to change their consumption habits (Graça et al., 2015). Along these lines, ensuring that plant-based alternatives maintain desirable sensory attributes is fundamental for a successful change in dietary choices (de Boer, Schösler, & Aiking, 2018; Spencer et al., 2018). Indeed, the sensory properties of plant-based products have been shown to play an important role in consumers' acceptance of these products (De Bakker & Dagevos, 2012; Neville et al., 2017), such that sensory appeals have been proven more successful than health and environmental claims (Marty, Chambaron, Nicklaus, & Monnery-Patris, 2018; Spencer, Rowe, Bonnell, & Dalton, 2021).

The advantage of hybrid products is that they bring the best of two now opposing meat/plant worlds, carrying both aura of good taste and nutrition (Bohrer, 2017; Graça et al., 2015; Tarrega et al., 2020), as well as healthiness and sustainability (Banovic et al., 2018; de Boer & Aiking, 2020). At the same time, it supports the suggested smaller portions of meat supplemented with more plant protein (de Boer & Aiking, 2020; de Boer, Schösler, & Aiking, 2014). Furthermore, it provides more diversity, and a more flexible approach to enable a sustainable plant-forward transition. Indeed, previous research has found that hybrid products are generally liked because of their sensory attributes, with consumer acceptability levels being in line with full meat products, whereas plant-based meat analogues are found to be less acceptable (Grasso, Rondoni, Bari, Smith, & Mansilla, 2021; Neville et al., 2017). Hybrid products would thus allow and encourage a more nuanced plant-forward transition of those consumers with an attachment to meat who would like to decrease the meat consumption but do not want to compromise on the taste and sensory reward (Circus & Robison, 2019; Graça et al., 2015). This will generate more sustainable dietary habits, but also have a positive influence on individual health, reducing the rates of NCDs, and obesity (Godfray et al., 2018). Research also shows that the substitution of up to 50% of meat (namely beef) with plant-based sources would achieve substantial reduction in GHG emissions, depletion of natural resources, water consumption, and land occupation (Goldstein et al., 2017). In this sense, hybrid products would not only contribute to the mitigation of climate change, but would also ease the challenges of the EU livestock sector towards a more sustainable management of natural resources (Santini et al., 2017), while providing a more diverse and added-value choice for consumers (Lang, 2020; Spencer et al., 2021). However, it is still unclear whether the option of products blending meat and plant-based ingredients would encounter resistance from consumers who are regular meat eaters (De Boer,

Schösler, & Boersema, 2013), because of the clash between the benefits of more plant-forward options and meat having a central place in their diets.

Nonetheless, these barriers to the consumption of plant-based alternatives might be attenuated when it comes to hybrid products as there is a meat component in the product (De Bakker & Dagevos, 2012). Unlike fully plant-based products, hybrid products are perceived as having the same sensory attributes of full meat products (Lemken, Spiller, & Schulze-Ehlers, 2019; Neville et al., 2017), suggesting that these products could help the transition of sceptical consumers from 100% meat products to a more plant-forward diet (De Bakker & Dagevos, 2012; Tarrega et al., 2020). Previous research has shown that substituting 50% or 80% of beef with plant-based ingredients maintains consumer acceptance ratings (Guinard et al., 2016; Myrdal Miller et al., 2014; Spencer & Guinard, 2018). Furthermore, regular meat eaters are often not willing to reduce their meat consumption and find it hard to follow a strictly vegetarian or vegan diet (Spencer et al., 2018) but they are interested in finding new ways for eating healthier (Lang, 2020). Indeed, meat consumers report the same level of health consciousness as consumers who still moderately eat meat but also consume fully plant-based alternatives (Hoek, Luning, Stafleu, & de Graaf, 2004). However, it is an open question whether consumers' health consciousness affects their attitude toward partially substituted meat, despite hybrid products providing a healthier solution without the need for a drastic dietary shift. Some indications from prior research show that a flexitarian diet could be a viable approach, which might allow for a large share of the population to practice a more plant-forward diet (de Boer et al., 2018; Sogari et al., 2021; Spencer & Guinard, 2018). This would ultimately have a greater benefit for both public health and environment than the change brought up by a small number of individuals following vegetarian or vegan diets (Pais et al., 2020). Finally, while prior research has extensively explored the role of consumers' concern for the environment and its impact on moving towards more plant-forward diets (Banovic & Otterbring, 2021; de Boer et al., 2018; Goldstein et al., 2017; Spencer et al., 2021), there is a lack of research about how this could influence consumers' attitude towards hybrid products. Yet, the limited evidence available hints that consumers with a higher level of care for nature could be the ones more willing to choose meals with reduced meat content (De Boer et al., 2013), thus potentially perceiving hybrid products as more acceptable. From now on when referring to the hybrid product(s), we are referring to the hybrid meat product(s).

1.2. Conceptual framework and aim of the study

Based on the above and focusing on regular meat eaters, we expect that the intention to buy hybrid products is influenced by the consumers' attitude towards a plant-based diet. This is in line with evidence showing that hybrid products could be considered as a meat substitute, while at the same time having the properties of and allowing consumers to enjoy meat (e.g. de Boer et al., 2018). Consistently, we expect that the effect of plant-based attitude on attitude and intention to buy hybrid products is mediated by consumers' sensory perception of hybrid products, as meat eaters consider these products and regular meat equally acceptable in terms of their sensory properties (Neville et al., 2017; Spencer & Guinard, 2018; Tarrega et al., 2020). This is especially true for those consumers with attachment to meat, in the sense that they feel an *affinity* towards the positive attributes of meat and they view it as a source of pleasure (*hedonism*), while also perceiving its consumption as a right (*entitlement*) and a necessity (*dependence*) (Graça et al., 2015). Thus, we expect that meat attachment has an influence on consumers' plant-based attitude and attitude toward hybrid products. Nonetheless, meat eaters are often looking for healthier options without reducing their meat consumption (Lang, 2020); thus, we expect that health consciousness influences consumers' plant-based attitude and their attitude towards hybrid products. Similarly, given the more sustainable nature of hybrid products, when compared to traditional meat (Spencer &

Guinard, 2018), we expect that the extent to which consumers see themselves as a type of person who acts environmentally-friendly affects their plant-based attitude and their attitude towards hybrid products (Cheah, Shimul, Liang, & Phau, 2020; Van der Werff, Steg, & Keizer, 2013). Fig. 1 shows the overall conceptual framework.

Based on the proposed conceptual framework (Fig. 1), the main aim of the study was to examine whether consumers' intention to buy hybrid products would be affected by consumers' plant-based attitudes, their expectations concerning sensory perceptions of and attitudes towards hybrid products. We further investigate whether plant-based attitude and attitude towards hybrid products would mediate the effect of individual consumer traits, namely meat attachment (i.e., affinity, hedonism, dependence and entitlement), health consciousness, and environmental self-identity on intention to buy. Finally, we also test whether sensory perceptions towards hybrid products mediate the relationship between plant-based attitude and attitude towards hybrid products.

The presented model in Fig. 1 has been tested across three selected European countries, namely Denmark (DK), Spain (ESP), and the UK. The country selection was based on the main markets where hybrid products are already present (DK; Fortune, 2019), important growing markets (the UK; Mintel, 2019), and potential market (ESP).

2. Methodology

2.1. Hybrid product selection

Stimulus for hybrid products was developed based on the existing products on the market (i.e., 50% beef, 50% plant-based ingredients; Fortune, 2019) and previous consumer research in the selected countries (Barone et al., 2021). This research has shown that consumers positively perceive and would be willing to accept hybrid products having partial meat-substitution with plant-based ingredients (preferable 50/50 concept), with beef being preferred as base meat, and bean and oat protein being favoured as plant-based ingredients. This is in line with previous consumer studies showing that oat, but also rapeseed and soy protein, could be an acceptable - sustainable and healthy - source of plant protein (Banovic et al., 2018; Banovic & Otterbring, 2021; Banovic & Sveinsdóttir, 2021). Building on this evidence, we included bean, pea, oat, rapeseed, and soy protein as potential plant-based ingredients.

2.2. Participants

Prior the study launch, ethical approval was granted by the University's ethical committee. A total of 2766 participants were subsequently recruited across selected countries (i.e., DK, ESP, and the UK) to participate in an online survey, with approximately 900 participants per country. All the data across selected countries was collected through Qualtrics software using representative samples of the Danish, Spanish and the UK population recruited via an ESOMAR (European Society for Opinion and Marketing Research) accredited market research agency (ICC/ESOMAR, 2016). The selected participants were main decision makers or sharing the responsibility for household food purchases. Participants were also meat consumers, as the goal of the study was to target low to heavy meat and beef consumers and assess their tendency for buying hybrid products. Thus, participants who did not consume meat were screened out from the survey. As seen from Table 1, there was no significant differences across countries in terms of age and gender, with average age of 42 years and having around 51% of female participants across countries. As expected, differences across countries have been observed for meat consumption in accordance with FAO (2021), where Spain had a highest consumption frequency of total meat, followed by Denmark, and the UK.
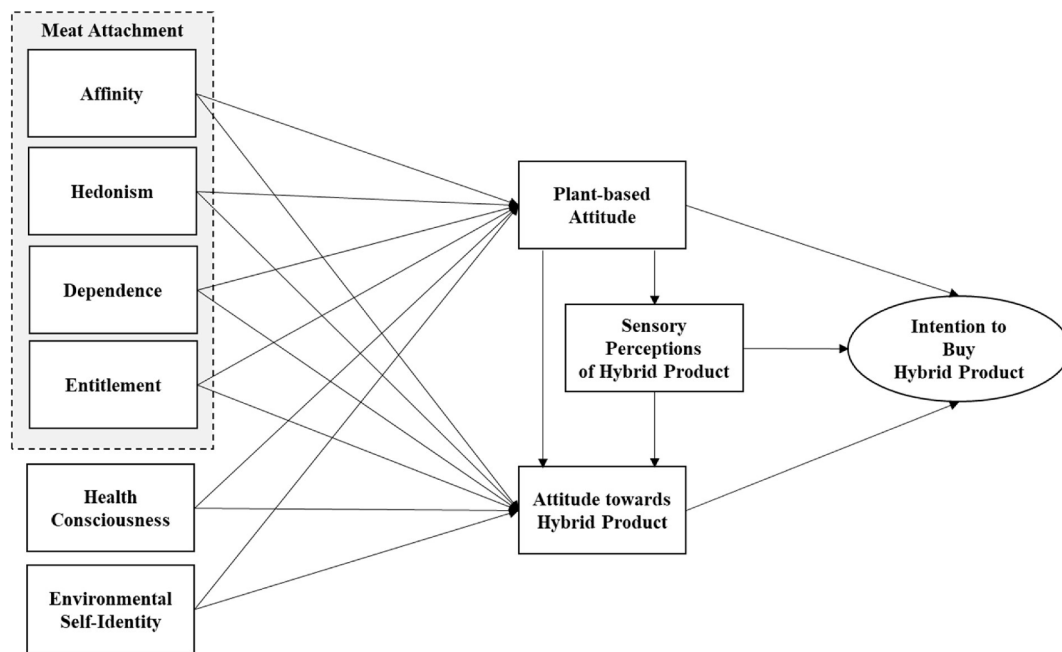
Fig. 1. Conceptual framework.

2.3. Procedure and measures

An online questionnaire was distributed in Denmark, Spain, and the UK, where participants were first introduced to the study, asked for their consent, and screened-out based on their meat consumption. Measures and stimulus, originally developed in English, were translated into Spanish and Danish, using a double-back-translation method with independent translators to ensure all meanings were the same across the three countries. In accordance with the hypothesized conceptual framework (Fig. 1), and after reading and signing the informed consent, participants were shown a series of questions measuring individual traits, plant-based attitude, sensory perception of hybrid product, attitude toward hybrid product, and intention to buy hybrid product. All the measures are shown in Table 2. Specifically, four factors were used to assess individual *meat attachment* (Graça et al., 2015), namely *affinity* (4 items), *dependence* (5 items), *entitlement* (3 items), and *hedonism* (4 items), all assessed on a seven-point Likert scales (1 = strongly disagree, 7 = strongly agree). Subsequently, *health consciousness* (Michaelidou & Hassan, 2008) was assessed using 4 items, while *environmental self-identity* with 3 items (Van der Werff et al., 2013) on seven-point Likert scales (1 = strongly disagree, 7 = strongly agree). Further, participants' *plant-based attitude* was assessed through 7 items also on a seven-point Likert scales (1 = strongly disagree, 7 = strongly agree) to account for barriers and facilitators towards adopting a more plant-based diet (Reipurth, Hørby, Gregersen, Bonke, & Cueto, 2019). To be able to measure consumers' perceptions, attitudes, and intention to buy hybrid product, participants were first presented with the definition of a hybrid burger stating that this is a product in which part of the beef is replaced the plant-based ingredients, such as bean, pea, oat, rapeseed, or soy proteins. Subsequently, participants were exposed to a picture of a hybrid burger together with a description defining the composition of the product (i.e., "50% plant-based, 50% beef", see Fig. 2). After the image, we measured participants' *sensory perceptions* with 3 items on a seven-point bipolar scale (1 = very poor, 7 = very good) (Elder & Krishna, 2010). *Attitude towards hybrid product* was assessed with a 3-items bipolar scale (1 = negative, 7 = positive; 1 = unfavourable, 7 = favourable; and 1 = bad, 7 = good) (Kees, Burton, & Tangari, 2010). Finally, *intention to buy hybrid products* contained likelihood of buying five plant-based ingredients: bean, pea, oat, rapeseed, or soy protein,

each measured on a seven-point bipolar scale (1 = very unlikely, 7 = very likely) (Van der Werff et al., 2013). The survey finished with participants' socio-demographic characteristics (Table 1).

2.4. Data analysis

The model in Fig. 1 was tested by using a multi-group structural equation modelling (SEM) in AMOS 27.0, using the country as a moderator (Byrne, 2013). Besides measures presented in Fig. 1, age, gender, and consumption frequency of meat, beef, and plant-based products have been additionally used as the control variables for the dependent variable – i.e., intention to buy hybrid products. A confirmatory factor analysis (CFA) was first conducted to test for reliability and validity of underlying measures presented in Fig. 1 and Table 2, (Hu & Bentler, 1999). To establish convergent and discriminant validity, as well as reliability, of the measurement model we assessed the Composite Reliability (CR), Average Variance Extracted (AVE), Maximum Shared Variance (MSV), as well as inter-construct correlations, where the threshold for these values are as follows: CR > 0.7, AVE > 0.5, MSV < AVE, and square root of AVE greater than inter-construct correlations (Byrne, 2013). Further, we assessed the measurement invariance across groups through configural, metric, and scalar invariance based on changes in the model fit (Steenkamp & Baumgartner, 1998). Further, we tested multi-group moderation (i.e., country differences) using critical ratios and chi-square difference test (Gaskin, 2019). Finally, the possible mediation effects were evaluated using user-defined estimand and plugin for AMOS (Gaskin, James, & Lim, 2020). To assess the model fit, several Goodness-of-Fit (GOF) measures have been applied (Byrne, 2013): chi-square divided by degrees of freedom ($\chi2/df < 5$), root mean square error of approximation (RMSEA < 0.05), goodness-of-fit index (GFI > 0.95), comparative fit index (CFI > 0.95), and Tucker–Lewis Index (TLI > 0.95).

3. Results

3.1. Cross-country differences

When looking at meat attachment factors (Table 2), it appears that participants across all countries scored higher on those factors related to

Table 1

Sociodemographic characteristics and consumption frequency of the participants.

Characteristics	TotalN = 2766	Denmark N = 947	SpainN = 928	UKN = 891	p – value[x]
Gender (% female)	51.2	52.5	49.8	51.3	0.670
Age (mean)[y]	41.7	41.8	42.0	41.5	0.615
Age (classes) (%)					
-≤31	23.0	26.6	19.5	22.8	<0.001
− 32–41	25.6	19.3	28.3	29.5	
− 42–51	26.2	27.5	28.0	23.1	
− 52+	25.2	26.6	24.2	24.6	
Marital status (%)					
- married/co-habiting	63.3	59.9	66.1	64.2	<0.001
- single-living with parents	9.8	4.4	16.4	8.8	
- single-living independently	23.5	33.1	12.4	24.8	
- other (widowed, divorced)	3.4	2.6	5.2	2.2	
Children (yes, %)	59.4	54.3	60.8	63.3	<0.001
Education (%)					
- primary school	2.8	6.0	1.1	1.1	<0.001
- secondary school	15	9.4	13.7	22.2	
- higher education (not university)	26.1	29.5	15.1	33.9	
- university (first degree, BSc)	31.5	38.9	22.7	32.7	
- university (postgraduate, MSc, PhD)	24.7	16.3	47.4	10.1	
Financial situation (mean, scale 1-poor;7-good)[y]	4.4	5.1[a]	3.9[b]	4.3[c]	<0.001
Consumption frequency (%)					
Meat					
- once a week and less	27.2	29.8	19.1	29.9	<0.001
− 2 to 4 times a week	36.7	15.9	46.3	48.8	
− 5 times a week and more	37.1	54.3	34.6	21.3	
Beef					<0.001
- once a week and less	44.0	23.3	37.1	73.1	
− 2 to 4 times a week	44.4	54.8	53.1	24.4	
− 5 times a week and more	11.6	21.9	9.8	2.6	
Plant-based products					<0.001
- once a week and less	54.8	65.2	56.0	42.4	
− 2 to 4 times a week	33.9	26.6	31.1	44.7	
− 5 times a week and more	11.3	8.2	12.8	12.9	

[x] p - value associated to the χ^2 - test.

[y] p - value associated to the F - test.

[a] Post-hoc Tukey t - test associated with F-test, means with different letters are significantly different at $p < 0.05$ level.

attributes and pleasure associated with meat (i.e., affinity, hedonism), while scoring lower on factors related to meat consumption perceived as a right and a necessity (i.e., entitlement, dependence). The factors that stand out are the affinity to positive attributes associated to meat and hedonism related to the pleasure of eating meat that show higher average means compared to other two meat attachment factors ($M_{Affinity}$ = 5.58; $M_{Hedonism}$ = 4.79). For the affinity factor, this was particularly evident for Danish participants, who scored higher than those in the UK and Spain ($M_{Aff.DK}$ = 6.13 vs. $M_{Aff.ESP}$ = 5.45 vs. $M_{Aff.UK}$ = 5.12). Conversely, Danish participants felt less entitled when asked about their right to consume meat ($M_{Ent.DK}$ = 4.30) than Spanish ($M_{Ent.ESP}$ = 4.72) and UK respondents ($M_{Ent.UK}$ = 4.66). The average score across countries

for the dependence factor was the lowest ($M_{Dependence}$ = 4.10), and no significant differences were observed, meaning that all participants did not feel particularly dependent on meat being a necessity in their diet ($M_{Dep.DK}$ = 4.05, $M_{Dep.ESP}$ = 4.14, $M_{Dep.UK}$ = 4.11). In terms of health consciousness and environmental self-identity, participants reported more concern about their health rather than the environment (M_{Health} = 5.11, $M_{Env.Selfld}$ = 4.68), with Spanish participants reporting the highest score on both measures ($M_{Health.ESP}$ = 5.37, $M_{Env.Selfld.ESP}$ = 5.29).

Participants across the countries were generally impartial towards a plant-based diet ($M_{Plantbased}$ = 4.05), in line with the sample being composed of regular meat eaters. When shown the image of hybrid products, overall sensory perception ($M_{Sensory}$ = 4.90) and attitude ($M_{Attitude}$ = 5.05) towards hybrid products were generally positive, with Spanish participants on average scoring the highest ($M_{Sensory.ESP}$ = 5.34, $M_{Attitude.ESP}$ = 5.49), followed by the UK ($M_{Sensory.UK}$ = 4.90, $M_{Attitude.UK}$ = 4.97), and Denmark ($M_{Sensory.DK}$ = 4.47, $M_{Attitude.DK}$ = 4.69). Intention to buy hybrid products was somewhat lower when compared to attitude, depending on the considered plant-based ingredient. Specifically, intention to buy was the lowest when hybrid products contained rapeseed ($M_{Rapeseed}$ = 3.68) and soy (M_{Soy} = 3.95) protein. This was particularly true for Spanish participants who showed lowest levels of appropriateness for rapeseed protein ($M_{Rapeseed}$ = 3.17), mainly due to their lower levels of familiarity with this plant-based ingredient, while Danish participants had lower preference for soy protein (M_{Soy} = 3.60). On the other hand, intention to buy hybrid products was highest when containing pea (M_{Pea} = 4.20), followed by bean (M_{Bean} = 4.15), and oat (M_{Oat} = 4.09) protein. Pea protein was preferred by Spanish participants ($M_{Pea.ESP}$ = 4.33), while bean protein was preferred among the UK participants ($M_{Bean.UK}$ = 4.45) as an appropriate ingredient for the hybrid products. Among Danish participants both pea and bean proteins were found as appropriate parts of the hybrid products ($M_{Pea.DK}$ = 4.04; $M_{Bean.DK}$ = 4.07).

3.2. CFA and measurement invariance analysis

A confirmatory factor analysis was conducted to confirm the factor structure across countries and dimensional variance. As seen from Table 3, all the models show satisfactory GOF measures, and the factor structure is supported across countries demonstrating dimensional variance. All the observed measures loaded significantly on their underlying latent constructs with the factor loadings ranging from 0.51 to 0.98 (all p_s < 0.001) across the constructs and countries (see Table 3). All the factors explained>50% of the variance of each measure, confirming internal consistency. In terms of reliability and validity, first the CR threshold of 0.70 was met on all factors and across countries. Second, AVE was at all times>0.50 for all latent constructs and across countries, confirming convergent validity. Furthermore, MSV was lower than AVE for all latent constructs and across countries supporting discriminant validity. Likewise, the AVE was always greater than inter-construct correlations across countries, thus further supporting discriminant validity. Finally, measurement invariance analysis showed that measures were invariant across countries and the models had a good fit (unconstrained model: $\chi2/df$ = 3.63, RMSEA = 0.03, GFI = 0.98, CFI = 0.98, TLI = 0.95) that provided reasonable evidence in support of measurement invariance (i.e. metric invariance: $\Delta\chi2(52)$ = 64.59, p = 0.113; scalar invariance: $\Delta\chi2(80)$ = 94.45, p = 0.129), permitting a meaningful comparison between the countries.

3.3. Multi-group SEM

A multi-group SEM was applied to estimate the model in Fig. 1, and to account for differences between the countries, Table 4. The chi-square difference test has been used to examine whether there is a difference between the groups at the model level and if comparisons across countries can be made. Thus, unconstrained model has first been assessed where path coefficients were freely estimated across the countries,

Table 2
Measures across the countries.

Measures	TotalN = 2766		DenmarkN = 947		SpainN = 928		UKN = 891		p –value
	mean	α^{+}	mean	α	mean	α	mean	α	
Affinity (MA[1])	5.58	0.93	6.13[a]	0.90	5.45[b]	0.93	5.12[c]	0.93	<0.001
- By eating meat I'm reminded of the death and suffering of animals. (MAA1)*									
- To eat meat is disrespectful towards life and the environment. (MAA2)*									
- I feel bad when I think of eating meat. (MAA3)*									
- - Meat reminds me of diseases. (MAA4)*									
Dependence (MA)	4.10	0.83	4.05[a]	0.75	4.14[a]	0.87	4.11[a]	0.88	0.360
- I don't picture myself without eating meat regularly. (MAD1)									
- If I couldn't eat meat I would feel weak. (MAD2)									
- I would feel fine with a meatless diet. (MAD3)*									
- If I was forced to stop eating meat, I would feel sad. (MAD4)									
- Meat is irreplaceable in my diet. (MAD5)									
Entitlement (MA)	4.55	0.89	4.30[a]	0.90	4.72[b]	0.90	4.66[b]	0.87	<0.001
- To eat meat is an unquestionable right of every person. (MAE1)									
- According to our position in the food chain, we have the right to eat meat. (MAE2)									
- Eating meat is a natural and indisputable practice. (MAE3)									
Hedonism (MA)	4.79	0.94	4.89[a]	0.93	4.65[b]	0.95	4.82[a]	0.92	0.003
- To eat meat is one of the good pleasures in life. (MAH1)									
- I love meals with meat. (MAH2)									
- I'm a big fan of meat. (MAH3)									
- A good steak is without comparison. (MAH4)									
Health consciousness	5.11	0.89	5.03[a]	0.91	5.37[b]	0.91	4.93[a]	0.85	<0.001
- I reflect about my health a lot. (HC1)									
- I'm very self-conscious about my health. (HC2)									
- I'm alert to changes in my health. (HC3)									
- I'm usually aware of my health. (HC4)									
Environmental self-identity	4.68	0.94	4.07[a]	0.94	5.29[b]	0.94	4.68[c]	0.94	<0.001
- Acting environmentally-friendly is an important part of who I am. (ESI1)									
- I am the type of person who acts environmentally-friendly. (ESI2)									
- I see myself as an environmentally-friendly person. (ESI3)									
Plant-based attitude	4.05	0.87	3.91[a]	0.89	4.15[b]	0.84	4.09[b]	0.89	<0.001
- It is good for the environment to eat more plant-based. (PBA1)									
- Plant-based food tastes good. (PBA2)									
- It is healthy to eat a plant-based diet. (PBA3)									
- It is easy to eat plant-based in social situations. (PBA4)									
- It is cheap to eat a more plant-based diet. (PBA5)									
- I get enough protein if I eat a more plant-based diet. (PBA6)									
- I become full from eating plant-based food. (PBA7)									
Sensory perception of hybrid product	4.90	0.95	4.47[a]	0.94	5.34[b]	0.95	4.90[c]	0.94	<0.001
- Quality (SPQ1).									
- Taste (SPT2).									
- Delicious (SPD3).									
Attitude toward hybrid product	5.05	0.97	4.69[a]	0.97	5.49[b]	0.97	4.97[c]	0.96	<0.001
- Negative/positive (ANP1).									
- Unfavourable/favourable (AUF2).									
- Bad/good (ABG3).									
Intention to buy hybrid product	4.45	0.96	3.87[a]	0.94	3.98[a,b]	0.89	4.20[b]	0.93	<0.001
- Bean protein (IBB1).									
- Pea protein (IBP2).									
- Oat protein (IBO3)									
- Rapeseed protein (IBR4)- Soy protein (IBS5).									

p-value associated with the ANOVA test where country has been used as a factor.

*Reverse-scored items.

[a,b,c] Posthoc Tukey t-tests associated with ANOVA, means with different letters are significantly different.

[1] MA: Meat attachment.

[+] Cronbach alpha.

exhibiting satisfactory GOF indices ($\chi2$/df = 2.20, RMSEA = 0.02, GFI = 0.99, CFI = 0.99, TLI = 0.98). Further, the model has been constrained to be equal across the countries, where model comparison analysis showed that groups (i.e., countries) are not different at the model level ($\Delta\chi^2(56) = 69.82$, $p = .101$) allowing for the analysis at the path level, where group (i.e., country) differences were assessed using chi-square difference test.

As seen from Table 4, the results show that plant-based attitude is strongly and negatively affected by affinity towards meat consumption followed by meat dependence, showing that meat attachment inhibits the participants' openness towards plant-based diet. The strongest effect of the affinity was observed among the Spanish ($\beta = -0.42$, $p < .001$) and the UK participants ($\beta = -0.39$, $p < .001$), while dependence or belief about the meat necessity was strongest among the UK participants

($\beta = -0.32$, $p < .001$). Conversely, the plant-based attitude was affected by the entitlement to eat meat only in Denmark ($\beta = -0.21$, $p < .001$) and Spain ($\beta = -0.10$, $p < .01$), and by hedonism only in the UK ($\beta = -0.09$, $p < .05$). As expected, consistently across all countries, plant-based attitude was positively influenced by health consciousness and environmental self-identity (all $p_s < 0.001$), with a smaller effect of health consciousness among Danish participants ($\beta = 0.05$, $p < .05$).

When confronted with hybrid products, the meat attachment factors had a lower explanatory power when it came to the attitude towards hybrid products; however, affinity and hedonism had a positive effect on attitude. Specifically, affinity towards meat had a positive effect on the attitude toward hybrid products in Spain ($\beta = 0.08$, $p < .01$) and in the UK ($\beta = 0.06$, $p < .05$), while hedonism had a positive effect in the UK ($\beta = 0.14$, $p < .001$). This indicated that presence of meat in hybrid

Fig. 2. Hybrid product.

products may override the consumers' negative taste perceptions compared to fully plant-based alternatives. On the contrary, dependence on meat consumption can negatively affect attitude, which was evident in the UK ($\beta = -0.17$, $p < .05$). Health consciousness had no significant effect on the attitude towards hybrid products (all $p_s > 0.05$), while there was a significant effect of environmental self-identity only in the UK ($\beta = 0.07$, $p < .05$), pointing that UK participants saw the hybrid products as a potentially more environmentally friendly product.

Plant-based attitude positively affected participants' attitude towards hybrid products in Denmark ($\beta = 0.10$, $p < .001$) and in the UK ($\beta = 0.07$, $p < .05$). This suggests that, even though regularly eating meat, in these countries participants open towards a plant-based diet still consider hybrid products as acceptable. Specifically, this effect was explained by the sensory perceptions of hybrid products, which are influenced by the plant-based attitude and in turn affect attitude towards hybrid products (all $p_s > 0.001$). This shows that sensory perceptions of hybrid products play an important role in an overall assessment of the hybrid product acceptability.

Finally, as presumed, the intention to buy hybrid products was affected by participants' plant-based attitude and their sensory perceptions of and attitude towards hybrid products (all $p_s > 0.001$). While there was no difference between the countries in terms of sensory perceptions, the attitude towards hybrid products had a varying effect on the intention to buy. Specifically, the strongest effect was observed in Denmark ($\beta = 0.35$, $p < .001$), followed by the UK ($\beta = 0.25$, $p < .001$), and Spain ($\beta = 0.14$, $p < .001$).

3.4. Control variable effects

Concerning control variables (Table 4), age was only significant in Denmark, negatively influencing intention to buy hybrid products ($\beta = -0.05$, $p < .05$), and showing that younger participants have a higher interest towards hybrid products than older participants do. The effect of gender was only significant in the UK ($\beta = -0.08$, $p < .01$), with male participants being more prone to purchase hybrid products when compared to their female counterparts. Consumption frequency of plant-based products significantly affected purchase of hybrid products in Spain ($\beta = 0.14$, $p < .001$) but not in Denmark and UK. This demonstrates that those Spanish participants belonging to the flexitarian group (moderately eating meat), and who already buy and consume plant-based products would be more willing to try hybrid products than those who are not experienced with plant-based products.

3.5. Mediating effects

As seen from Table 4, plant-based attitude mediates the effect of the meat attachment factors, affinity and dependence, on intention to buy

hybrid products across all three countries (all $p_s < 0.01$). Conversely, plant-based attitude mediates the effect of entitlement in Denmark and Spain, and the effect of hedonism in the UK. Additionally, the same mediating effect of plant-based attitude was observed for the environmental self-identity across all countries, whereas for health consciousness this was supported only for Spain and the UK (all $p_s < 0.01$). Finally, sensory perceptions of hybrid products mediate the influence of plant-based attitude on both attitude and intention to buy hybrid products across all countries (all $p_s < 0.01$). This further confirms the key role of sensory perceptions in the understanding of attitudes and behavioural intentions towards hybrid products.

4. Discussion

This is the first cross-cultural study to investigate European consumers' attitudes and intention to buy hybrid products involving blend of meat and plant-based ingredients, shedding light on this largely neglected area of study about these sustainable products. Within this research, we have found considerable evidence that hybrid products could be a crucial catalyst for enabling successful plant-forward transition and reduce reluctance towards consumption and negative perceptions of plant-based alternatives (Neville et al., 2017; Tarrega et al., 2020). Indeed, we show that regular meat consumers have positive sensory perception, high attitude towards and high intention to buy hybrid products. This indicates that even though hybrid products possess attributes of more than one product category (i.e. both meat and plant-based ingredients), consumers likely categorized them and perceive them as more prototypical of the meat category. This suggests that hybrid products that better resemble the prototype of a particular product category could invoke more favourable attitudes and acceptance (Gregan-Paxton et al., 2005; Rajagopal & Burnkrant, 2009). Indeed, we further show that this effect is robust and does not reduce the appeal of a hybrid product as it holds even among consumers highly attached to meat. Specifically, we found that even consumers with higher affinity towards meat sensory attributes and pleasure associated with meat consumption (i.e., hedonism) had substantially positive attitudes towards hybrid products. This corroborates findings from previous studies showing that substituting meat with plant-based ingredients might sustain consumer acceptance and prevent the negative taste perceptions associated with fully plant-based alternatives (Guinard et al., 2016; Lemken et al., 2019; Marty et al., 2018; Myrdal Miller et al., 2014; Spencer & Guinard, 2018; Tarrega et al., 2020), leading to more sustainable diets (Pais et al., 2020). In line with the previous, we also show that different plant-based ingredients can have varying effect on the intention to buy hybrid products, suggesting the role that familiarity, prototypicality, and previous experience with this product category have in affecting consumers' acceptance of these products (Banovic & Otterbring, 2021; Banovic & Sveinsdóttir, 2021; Rajagopal & Burnkrant, 2009; Tarrega et al., 2020).

In terms of cross-country differences, the above effects hold across countries showing that sensory perceptions of hybrid products highly affect an overall attitude towards hybrid product with stronger effect among the UK consumers when compared to Danish and Spanish consumers. Sensory perceptions also mediate the effects of different beliefs about plant-abased ingredients on both attitude and intention to buy hybrid products, with more prominent effect in Denmark and the UK. We found that this effect of attitude towards plant-based diet on both attitude towards and intention to buy hybrid products was mediated by sensory perception. This also corroborates previous research showing the significance of sensory appeal for reduced meat consumption and that choosing mixed (hybrid) products could be a reliable option especially for consumers who are attached to meat (Tarrega et al., 2020; Tucker, 2014). This is further supported in our study showing the negative effect of meat attachment (i.e. affinity towards the positive meat attributes) on overall plant-based attitude where the higher effect was observed again among UK, as well as Spanish consumers. While the

Table 3
Confirmatory factor analysis.

Measures	Overall				Denmark				Spain				UK			
	SE	CR	AVE	MSV	SE	CR	AVE	MSV	SE	CR	AVE	MSV	SE	CR	AVE	MSV
Affinity		0.93	0.76	0.23		0.90	0.70	0.17		0.93	0.78	0.25		0.93	0.76	0.33
MAA1	0.90*				0.86				0.90				0.89			
MAA2	0.86				0.78				0.90				0.88			
MAA3	0.90				0.88				0.89				0.91			
MAA4	0.83				0.82				0.85				0.80			
Dependence		0.84	0.72	0.43		0.79	0.67	0.46		0.87	0.59	0.55		0.89	0.61	0.33
MAD1	0.58				0.51				0.81				0.84			
MAD2	0.76				0.75				0.79				0.76			
MAD3	0.54				0.57				0.51				0.55			
MAD4	0.78				0.75				0.82				0.84			
MAD5	0.89				0.89				0.87				0.87			
Entitlement		0.89	0.73	0.50		0.90	0.75	0.53		0.90	0.76	0.51		0.87	0.68	0.48
MAE1	0.86				0.89				0.84				0.81			
MAE2	0.87				0.88				0.88				0.84			
MAE3	0.85				0.83				0.89				0.84			
Hedonism		0.93	0.79	0.61		0.94	0.79	0.67		0.95	0.82	0.55		0.93	0.76	0.64
MAH1	0.91				0.91				0.93				0.89			
MAH2	0.90				0.91				0.90				0.90			
MAH3	0.92				0.93				0.92				0.93			
MAH4	0.81				0.80				0.89				0.75			
Health consciousness		0.89	0.68	0.25		0.91	0.71	0.13		0.91	0.71	0.34		0.86	0.60	0.33
HC1	0.81				0.83				0.79				0.80			
HC2	0.85				0.90				0.89				0.79			
HC3	0.81				0.79				0.84				0.77			
HC4	0.82				0.85				0.86				0.74			
Environmental self-identity		0.93	0.83	0.25		0.91	0.78	0.18		0.94	0.84	0.34		0.94	0.84	0.33
ESI1	0.92				0.89				0.90				0.91			
ESI2	0.93				0.92				0.94				0.92			
ESI3	0.89				0.83				0.90				0.92			
Plant-based attitude		0.88	0.51	0.35		0.89	0.55	0.42		0.84	0.54	0.30		0.89	0.53	0.42
PBA1	0.70				0.74				0.69				0.67			
PBA2	0.81				0.85				0.75				0.81			
PBA3	0.78				0.82				0.77				0.74			
PBA4	0.57				0.54				0.49				0.68			
PBA5	0.55				0.61				0.42				0.57			
PBA6	0.75				0.77				0.68				0.79			
PBA7	0.78				0.81				0.74				0.81			
Sensory perception HP[1]	0.96	0.89	0.73		0.96	0.89	0.66		0.96	0.89	0.72		0.96	0.88	0.78	
SPQ1	0.93				0.95				0.92				0.91			
SPT2	0.95				0.95				0.95				0.96			
SPD3	0.94				0.93				0.96				0.94			
Attitude HP		0.98	0.95	0.73		0.99	0.96	0.66		0.98	0.93	0.72		0.98	0.93	0.78
ANP1	0.97				0.98				0.97				0.97			
AUF2	0.97				0.97				0.97				0.97			
ABG3	0.98				0.98				0.97				0.97			
Intention to Buy HP	0.92	0.70	0.34		0.94	0.77	0.35		0.90	0.63	0.30		0.93	0.73	0.37	
IBP1	0.87				0.91				0.81				0.89			
IBB2	0.89				0.92				0.87				0.88			
IBO3	0.85				0.90				0.85				0.84			
IBR4	0.77				0.86				0.64				0.84			
IBS5	0.80				0.81				0.78				0.83			
Goodness-of-fit (GOF) measures																
χ2/df		6.07				2.97				2.62				2.94		
GFI		0.99				0.98				0.98				0.99		
CFI		0.99				0.98				0.98				0.99		
TLI		0.96				0.96				0.96				0.97		
RMSEA		0.04				0.05				0.04				0.05		

[1]HP – Hybrid product; SE – Standardized Estimate; CR – Composite Reliability; AVE – Average Variance Extracted; MSV - Maximum Shared Variance. *All SE significant at $p < 0.001$.

effects of sensory perceptions on consumer acceptance of hybrid products have been documented in a few studies and generally linked to product's taste and sensory attributes (De Bakker & Dagevos, 2012; Neville et al., 2017; Spencer et al., 2021), previous literature on possible sustainable products has so far largely neglected the crucial role of sensory perceptions in plant-forward transition. We fill this gap by providing an explanation about why consumers' buying behaviour is often less healthy and environmentally sustainable than expected, namely due to the low expectations about sensory attributes of sustainable products and consumers' unwillingness to compromise on taste

and pleasure.

Additionally, we investigated whether consumers' personal traits such as meat attachment, health consciousness and environmental self-identity, would inhibit or facilitate consumers' purchase intention towards hybrid products. As expected, our results confirmed that consumers' plant-based attitude is negatively affected by meat attachment, which could be a barrier for consumers' openness towards plant-based diet. Conversely, health consciousness and environmental self-identity have a strong positive effect. These findings seem quite natural since consumers more attached to meat may have a more negative attitude

Table 4
Multi-group SEM results and comparison between countries.

Dependent variable	Predictor	Overall		Denmark		Spain		UK	
		SE	*R^2*	*SE*	*R^2*	*SE*	*R^2*	*SE*	*R^2*
Plant-Based Attitude (PBA)			0.37		0.44		0.33		0.41
	Affinity (MA[1])	-0.31***		-0.20*** (a)		-0.42*** (b)		-0.39*** (b)	
	Dependence (MA)	-0.23***		-0.25*** (a)		-0.18*** (b)		-0.32*** (a)	
	Entitlement (MA)	-0.09***		-0.21*** (a)		-0.10** (b)		-0.01 (b)	
	Hedonism (MA)	-0.01		-0.07(a)		-0.03 (a)		-0.09* (b)	
	Health Consciousness	0.12***		0.05* (a)		0.14*** (b)		0.14*** (b)	
	Environmental Self-Identity	0.20***		0.20*** (a)		0.19*** (a)		0.16*** (a)	
Attitude towards HP (A)			0.57		0.57		0.50		0.61
	Affinity (MA)	0.08***		0.03 (a)		0.08** (a)		0.06* (a)	
	Dependence (MA)	-0.02		-0.05 (a)		-0.01 (a)		-0.07* (a)	
	Entitlement (MA)	-0.03		-0.03 (a)		-0.01 (a)		-0.03 (a)	
	Hedonism (MA)	0.05**		0.02 (a)		0.06 (a)		0.14*** (b)	
	Health Consciousness	-0.01		-0.01 (a)		-0.01 (a)		-0.02 (a)	
	Environmental Self-Identity	0.06***		0.02 (a)		0.05 (a)		0.07* (a)	
	Plant-Based Attitude	0.11***		0.10*** (a)		0.03 (a)		0.07* (a)	
	Sensory Perceptions HP[2]	0.72***		0.69*** (a)		0.68*** (a)		0.74*** (b)	
Sensory Perceptions HP[2] (SP)			0.15		0.19		0.16		0.18
	Plant-Based Attitude	0.44***		0.58*** (a)		0.21*** (b)		0.47*** (a)	
Intention to Buy HP (IB)			0.45		0.47		0.38		0.53
	Plant-Based Attitude	0.45***		0.34*** (a)		0.58*** (b)		0.51*** (b)	
	Sensory Perceptions HP	0.19***		0.16*** (a)		0.24*** (a)		0.21*** (a)	
	Attitude towards HP	0.25***		0.35*** (a)		0.14*** (b)		0.25*** (c)	
Control variables									
Age		-0.01		-0.05* (a)		-0.02 (a)		-0.04 (a)(b)	
Gender		-0.02		-0.02 (a)		0.02 (a)		-0.08** (a)(b)	
Cons. freq. meat		0.02		0.03 (a)		0.04 (a)		0.05 (a)	
Cons. freq. beef		0.02		0.06* (a)		-0.01 (a)		-0.01 (a)(b)	
Cons. freq. plant-based products		0.09***		0.04 (a)		0.14*** (a)		0.05 (a)	
Mediating effects									
Affinity (MA) > PBA > IB		-0.14***		-0.07***		-0.24***		-0.20***	
Dependence (MA) > PBA > IB		-0.10***		-0.09***		-0.10**		-0.16***	
Entitlement (MA) > PBA > IB		-0.04**		-0.07***		-0.06**		-0.01	
Hedonism (MA) > PBA > IB		-0.01		-0.02		-0.02		-0.05*	
Health Consciousness > PBA > IB		0.05***		0.02		0.08***		0.07***	
Environmental Self-Identity > PBA > IB		0.09**		0.07***		0.11***		0.08***	
Affinity (MA) > A > IB		0.02***		0.01		0.02***		0.02*	
Dependence (MA) > A > IB		-0.01		-0.02		-0.01		-0.02*	
Entitlement (MA) > A > IB		-0.01		-0.01		-0.01		-0.01	
Hedonism (MA) > A > IB		0.01*		0.01		0.01		0.04***	
Health Consciousness > A > IB		-0.01		-0.01		-0.01		-0.01	
Environmental Self-Identity > A > IB		0.02***		0.01		0.01		0.02*	
PBA > SP > A		0.32**		0.40***		0.15**		0.35**	
PBA > SP > IB		0.09**		0.10***		0.05**		0.10***	
PBA > A > IB		0.02***		0.04**		0.01		0.01	

***Significant at $p < 0.001$. **Significant at $p < 0.01$.*Significant at $p < 0.05$.
[x]Path estimates with different letters across countries differ significantly at $p < 0.001$ level.
[+]Factor loadings of the unobserved variable - Intention to Buy Hybrid Product (IB).
[1] MA – Meat Attachment; [2]HP – Hybrid Product.

towards a plant-based diet (Graça et al., 2015), while consumers with higher levels of health and environmental consciousness would be more willing to choose a meatless diet (de Boer et al., 2014). While this result seems straightforward, and corroborates previous studies (Neville et al., 2017), we further answer the open question of whether consumers' health and environmental consciousness affects consumers' attitude towards new hybrid products with partial-substitution of meat. We find that despite hybrid products offering a healthier and more environmentally sustainable solution without the need for a radical dietary shift, this information is found less important by the consumers, with this effect holding across all investigated countries and particularly among Danish consumers. On the other hand, and as pointed above, the consumer attachment to meat, does not reduce the appeal of a hybrid product. In fact, hybrid products containing meat resonate well with consumers attached to meat as they tend to use the meat component rather than the plant-based component as cue when judging the product, thus leading to more favorable attitudes (Gregan-Paxton et al., 2005). This shows that the adoption of hybrid products, which centre on

bringing the best of two worlds, specifically the good sensory characteristics of the meat realm, and the healthiness and sustainability of the plant realm, could be an elegant initial strategy to be adopted by practitioners and supported by policy makers, for a more nuanced transition from fully meat-based to a plant-forward diet. However, only if manufacturers and retailers display hybrid products in places and settings in which these products evoke more familiarity with the meat product category rather than plant-related product category, would consumers attached to meat be able to quickly use a single category inference strategy and build more favourable attitudes.

4.1. Limitations and future research

This study has focused on consumer's attitudes and intention to buy hybrid products, using real-world stimuli but without testing these products in a real retail setting and accounting for actual consumer choices. Future research could address these limitations in several directions. Consumers experiments with hybrid products and in a market

setting (e.g., stores) using incentive-compatible methods, such as real choice experiments (Macdiarmid, Cerroni, Kalentakis, & Reynolds, 2021), or multiple price list and experimental auctions (Asioli, Mignani, & Alfnes, 2021) combined with sensory studies (Asioli et al., 2017), would be useful to provide more realistic information about consumer preferences and willingness to pay for hybrid products. Further, investigations of communication messages where specific goals (e.g., taste, health, and environment) could be taken into account may further allow for identifying persuasive paths for adoption of hybrid products. Moreover, additional research is needed on the role of sensory properties and expectations of hybrid products, particularly focusing on specific plant-based ingredients that could further increase product adoption. Finally, the replication of this study in other countries, especially non-European, would be further useful to deepen the understanding of consumers' attitudes towards hybrid products.

5. Conclusions and managerial implications

There are several important implications arising from our results that could help managers and policy makers understand the value of hybrid products and how to successfully market them to consumers. The key finding of our study is that companies should focus on improvement and communication of the sensory characteristics and pleasure derived from taste, rather than the environmental and health benefits associated with hybrid products. This is especially important as a common way for policy makers and managers to increase consumers' awareness about meat consumption issues is through health and sustainability positioning. For instance, managers usually identify positive features of new products, such as sustainability of plant-based alternatives, which might differentiate them enough to attract consumers, and they expect that consumers will in turn adjust their behavior accordingly by reducing meat consumption. Although this might appear as the natural decision, to reach a broader market and those consumers attached to meat, products that conflict with existing consumption habits are unlikely to be used (BEUC, 2020; EC, 2020b), with the result that consumers' buying behaviour is often less environmentally sustainable than recommended (Otto et al., 2021). Indeed, even though hybrid products are desirable healthy and sustainable alternatives, our study shows that sensory perceptions are crucial for consumer acceptance and should form an integral part of successful new hybrid product development.

Therefore, for a broader market and especially for those consumers attached to meat, who do not deal specifically with health and environmental concerns, the success of hybrid products will depend on two major factors. First, future hybrid products should be developed to resemble meat products in terms of taste, texture, and flavour, thus bringing both sides of the coin and fulfilling consumers' passion for meat while promoting more sustainable consumption practices. Efforts from policy makers should be thus made to encourage the consumption of hybrid products, raise awareness, familiarity, and support their introduction as these represent middle ground alternatives to traditional 100% meat or 100% plant-based foods that are perceived tasty (because of the meat element), but also sustainable and healthy (because of the plant element). Second, it has to do with communication and labelling of hybrid products, where first role should be unquestionably taken by the product quality itself and eliciting higher levels of sensory reward (i.e., pleasure), while labelling should play only a supporting role. Specifically, new hybrid products coming to the market should be easily perceived as having the same sensory attributes of full meat products by its overall appearance, which should be supported by suitable market communication, where green and health claims would have only a supplementary function. Thus, hybrid products positioned as mitigating the usual trade-offs between sensory reward and health and/or sustainability will be those with the higher market prospects. Even though many consumers may ignore the above claims, they should still be able to distinguish them as tasty meat alternatives. Some actors in the food industry have already recognized this tendency and are working on new

reformulations that can help support transition of the boarder market towards fair, healthy and environmentally-friendly food practices.

CRediT authorship contribution statement

Marija Banovic: Conceptualization, Methodology, Investigation, Formal analysis, Writing – review & editing. **Ada Maria Barone:** Conceptualization, Methodology, Investigation, Writing – review & editing. **Daniele Asioli:** Conceptualization, Writing – review & editing. **Simona Grasso:** Writing – review & editing, Funding acquisition.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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