Consumer awareness of sustainable supply chains: A choice experiment on Parma ham PDO

Abstract

Food production generates emissions at all stages, from the agricultural sector up to all other related inputs. At present, the livestock sector is one of the most significant contributors to environmental problems. For instance, the intensive European swine production system generates high external costs, such as water and air pollution. In response to these emerging issues, there is a growing interest in the relationship between marketing and sustainability, with people increasingly paying more attention to health, product quality and products' environmental friendliness. The aim of this study is to determine whether there is a market for high-quality Parma ham PDO (protected designation of origin), produced using a sustainable supply chain at environmental, health and animal welfare levels. This paper employs discrete choice experiments to investigate Italian consumers' preferences and willingness to pay (WTP) for Parma ham PDO with distinct characteristics, including the use of pollutant abatement technologies. The results seem to encourage the pork industry to better explore the reduction of pollutant emissions, demonstrating consumers' WTP for this production technology. Furthermore, the results of this study prove the existence of a niche market for this type of production.

Keywords: consumer behaviour, choice experiment, animal welfare, swine supply chain, sustainable production.

1. Introduction

Global pollutant emissions due to human activities have grown considerably since pre-industrial times, with an increase of 70% from 1970 to 2004. To reduce the risk of adverse effects from climate change, global pollutant emissions must be reduced by 50% globally and 80% in the developed world by 2050, compared to 1990 levels (Masson-Delmotte et al., 2018). According to this issue, the Sustainable Development Goal 12 of Agenda 2030 recommends the efficient management of common natural resources by encouraging industries, farms and consumers to make environmentally and socially sustainable choices.

At present, the livestock sector is one of the most significant contributors to environmental problems, with its activities leading to land degradation, water pollution and increased health problems (Steinfeld et al., 2006). In 2015, food system emissions were estimated at 18 billion tonnes of CO_2 or the equivalent produced (FAO, 2021). This is supported by the fact that this sector represents 30% of the Earth's surface and is responsible for one significant global asset worth at least US$1.4 trillion (Steinfeld et al., 2006). Apart from contributing 17% to the global food budget in terms of calories per person per day and 33% of protein in human diets, livestock can also promote biodiversity in some pastoral systems (Burlingame & Dernini, 2010). The animals that are mostly bred in the world's intensive farms are cattle, pigs and poultry (National Research Council, 2003). Since the 1970s, some regions have specialised in animal production, from which large-scale agglomeration economies appeared, leading to the formation of areas of high animal density. One example is the European swine production system, which is mainly intensive and generates high external costs, such as water and air pollution (Grinsven et al., 2018).

Apart from consuming large quantities of water, intensive livestock farms cause groundwater pollution due to animal manure. In fact, 70% of all water resources used worldwide are used in animal husbandry and agriculture, and most of these farming activities are not intended for humans but for livestock breeding (FAO, 2017). Moreover, the air inside pig barns is characterised by high concentrations of NH_3, CH_4 and PM (Mostafa et al., 2019). The high number of pigs reared on these large-scale farms and the massive amounts of feed distributed in these facilities contribute to the deterioration of air quality inside the barns, posing health risks to both the animals and workers

(Costantini et al., 2020). The same poor-quality air is then dumped into the environment, causing pollution in the surrounding rural and urban areas.

In response to these emerging issues, there has been a growing interest in the relationships between marketing and sustainability because people are beginning to pay more attention to health, product quality, and their environmental friendliness. In fact, in corporate marketing strategies, some communication tools have promoted social sustainability in food chains based on the principle of 'equally distributed well-being' (Agnusdei & Coluccia, 2022). These strategies include corporate social responsibility activities, ethical-based communication and heightened awareness of the environmental impact of production communications, thus showing the interest given by corporations to these issues (Sahadev et al., 2022). In terms of promoting sustainable consumption, marketing plays a role in stimulating more environmentally friendly consumption patterns (Fischer et al., 2021). Specifically, sustainable marketing is a branch of marketing that promotes consumer awareness through the purchase of products that respect the environment and people. Consumer demand for sustainable options is increasing; for example, 66% of consumers worldwide report a greater willingness to pay (WTP) for sustainable offerings (Nielsen, 2015). Nevertheless, there is still room for further innovation.

In the literature, two main approaches are usually employed to analyse consumer preferences (Czine et al., 2020). The first comprises the revealed preference methods, which observe the behaviours of individuals in real market situations, whilst the second consists of the stated methods, which compare consumers in a hypothetical situation to evaluate alternatives between the product attributes that are not yet available in the real market (Czine et al., 2020; Mark & Swait, 2004). This approach to assessing consumer preferences and defined product characteristics (i.e. attributes) is known as the discrete choice experiment (DCE) (Costanigro & Onozaka, 2020; Cummins et al., 2016). The DCE is used to calculate the trade-offs between different attributes of a product preferred by consumers compared to others (Tonsor et al., 2009). This approach is useful because it can simulate real-life purchase decisions, forcing consumers to make trade-offs between the different attributes of certain products to meet their needs (Grunert et al., 2018).

Consumers' interest in sustainable production processes is one of the major issues in the agri-food system. It concerns different themes, such as organic farming, biodiversity protection, eco-packaging

of products and water-reduction technologies. Amongst the current technologies used in the implementation of sustainable agri-food chains, the reduction of antibiotics in livestock production is one of the most highly debated topics to date (Denver et al., 2021; Waluszewski et al., 2021; Grunert et al., 2018). Concerning pork breeding, some scholars have addressed the issue of consumers' preferences for this production typology (Lusk, 2006; Denver et al., 2021; Grunert et al., 2018; Waluszewski et al., 2021). Nevertheless, according to the idea that the use of antibiotics in animal health care can lead to antimicrobial resistance, several practices and policies to reduce their use in livestock have been introduced all around the world (Denver et al., 2021). For example, in the pork food chain, the implementation of systems requiring the reduced use of antibiotics involves changing production management procedures and improving diagnostic tools to identify pathogens (Denver et al., 2021).

The increasing consumer interest in these kinds of products was first confirmed by Lusk et al. (2006) by applying a choice experiment with a money incentive outside grocery stores to estimate consumers' WTP for pork meat produced without the use of antibiotics, resulting in a price premium of 76%. Denver et al. (2021) focused on the reduction, rather than the elimination, of antibiotic use in the pork production chain, also controlling for the different motivations that consumers may have about the use of antibiotics, such as concerns about residues in pork meat and increased antibiotic resistance in microbials. Using an online questionnaire, they asked their respondents to imagine buying pork meat with 20% less antibiotics in stores and to declare their WTP for this kind of product, using a hypothetical approach without financial incentives. Their results confirmed consumers' WTP for the proposed product, although it was lower than that found in Lusk et al. (2006). The results reported by Denver et al. (2021) can be explained by the reduction of residues in meat and resistance in microbials, rather than in better livestock conditions.

Grunert et al. (2018) proposed an approach based on consumers' segmentation of trade-offs amongst several production-related attributes. They demonstrated that the production features improving individual benefits in terms of health and safety, rather than public benefits, are the most preferred attributes by consumers, including 'less use of antibiotics in pork meat production'. However, consumers' perceptions of sustainability issues in food chains differ between the EU and the rest of the world (Nocella et al., 2010). Thus, Waluzewski et al. (2021) affirmed the need to change the system of

the large-scale use of antibiotics in the pork production chain to a tailor-made system that employs sustainable breeding practices. They also analysed two European systems of breeding, the Swedish and the Italian systems, arguing that the latter's use of antibiotics in pig production is 20 times higher than that in the former, leading to one of the highest burdens of antimicrobial resistance throughout the EU (Waluzewski et al., 2021; Cassini et al., 2019). However, large Italian retailers have recently begun to demand reduced antibiotic use in pig farms, although these initiatives rest far from a large public, assuming the character of experimental marketing rather than being more widely applied (Waluzewski et al., 2021).

Many scholars have investigated several aspects of consumers' preferences for animal production while caring for animal welfare in several livestock industries, including poultry (Gerini et al., 2016), cattle (Mazzocchi & Sali, 2018), sheep and goats (Musto et al., 2015) and more recently, pigs (Denver et al., 2021; Lund et al., 2021). Concerning pork production, the minimum legislation standard of pork welfare has been set in EU regulations (Dir 2008/120/EC), but a higher standard can be adopted by each EU member state (Denver et al., 2022).

According to Cembalo et al. (2016), studies have mainly focused on two principal motivations guiding consumers in their purchasing choices related to livestock production: (1) concerns for animal conditions in breeding (Mazzocchi & Sali, 2018, 2021) and (2) the environmental impact of the livestock system (Eldesouky et al., 2018). The first branch of the literature refers to the attitudinal and moral drivers associated with consumer preferences for pork products (Lund et al., 2021). The main factors that have been extensively examined include general moral opinions (Frey & Pirscher, 2018), personal values (Cembalo et al., 2016) and concerns for animal welfare and consumer perceptions about farmers and the conditions of farmstock (Boogaard et al., 2006; Miranda-de la Lama et al., 2017). Following different perspectives, other studies have attempted to understand how consumer concerns about animal welfare can affect the ethical positioning of food companies (Beldad & Hegner, 2020). Some examples include the enclosed confinement of livestock and stocking density (de Barcellos et al., 2011), long-distance transport (Miranda-de la Lama et al., 2011) and religious aspects, such as Kosher slaughter practices (Fuseini et al., 2017).

The second group of studies investigates issues related to how consumers deal with livestock production attributes related to the environment, such as ammonia emissions, carbon footprint (Grunert et al., 2018), greenhouse gas (GHG) emissions and others (Burnier et al., 2021; Eldesouky et al., 2018).

The GHG emission attribute has been investigated in several papers that evaluated consumers' interest in purchasing products with a low carbon footprint (de Magistris and Gracia, 2016; Echeverría et al., 2014; Michaud et al., 2013; Tait et al., 2011). Moreover, in a recent study, Burnier et al. (2021) assessed the reduction of GHG emissions in percentage during beef production and estimated consumers' preferences for different levels of emission (0%, 30% and 60%). However, several questions remain unanswered: What are consumers' perceptions of the environmental impacts caused by pork livestock emissions? and Is there a premium price for reducing ammonia emissions in pork supply chains? To our knowledge, there is a gap in the literature between consumer preferences for pork meat and environmental issues related to emissions caused by farms, particularly ammonia emissions.

For these reasons, our study aims to estimate what kinds of attributes in acquiring Parma ham PDO (protected designation of origin) matter for consumers using a survey based on choice experiments (CEs). Furthermore, this research analyses which attributes amongst pollutant abatement technology (PAT), animal welfare, reduction of antibiotics and price are ranked higher by consumers when they make choices about Parma ham PDO purchases in Italy, as well as their WTP for these attributes.

The remainder of the paper is organised into sections. Section 2 provides a literature review of consumers' interest in sustainable practices in the pork supply chain. Section 3 presents the methodology (data collection, selection of attributes, experimental design and econometric model). Section 4 presents the results and a discussion of the findings. Finally, Section 5 draws the paper's conclusions.

3. Methodology

CEs facilitate the investigation of consumers' preferences for options or products that do not yet exist in the market (Mahmoudi et al., 2021). The idea underlying this methodology is to derive an individual's marginal utility by examining the trade-offs between the relevant attributes of a product when making purchase decisions. CEs introduce respondents to several purchase scenarios

(hypothetical or real) amongst alternative products that are described by combinations of various attributes at different levels. Consumers are then asked to choose which alternative product they would buy within each set of alternative options (choice set) based on the description provided, thus revealing their preference for specific attributes or levels and their relative degrees of importance (Train, 2009). Each attribute characterising the product, the combination of different attributes and their levels is represented in the sets of alternatives proposed.

3.1 Data collection

The data collection was performed through interviewers who used a CE survey built with Qualtrics software, thus allowing participants to access the questionnaire via different devices. The questionnaire was distributed through social media, web forums and individual contact lists to reach a large and diverse range of respondents. The questionnaire participants were randomly recruited. To ensure the accuracy of the questions and to avoid possible ambiguity regarding the items, a pre-test with 20 participants was carried out for two weeks at the beginning of November 2019. The pre-test was carried out by sending the questionnaire by e-mail to 20 respondents (students and colleagues). The aim of the pre-test was to verify the potential excessive length of the questionnaire and the clarity of the questions. The respondents' overall feedback was mostly positive; the interviewees answered without difficulty and correctly understood the questions included in the survey. From this pre-test, the suggestion to include in the questionnaire a question related to 'the usual site of purchase' of Parma ham PDO emerged. Thus, this feedback was considered, and the final questionnaire was adjusted accordingly.

Data collection was based on quota sampling criteria without any rewards. Data collection took place from December 2019 to April 2021[1], and the people interviewed all lived in areas scattered throughout Italy (South, Centre, North and Islands). During this time, 340 respondents answered the questionnaires, resulting in 319 complete documents (93.8% response rate). The participants consisted only of Parma ham consumers. This issue was verified by including a filter question before proposing the CE part of the survey.

[1] A first tranche of interviews took place in December 2019, a second tranche in April and May 2020 and a third tranche in April 2021.

Comparisons of average values did not identify significant differences between questionnaires that were returned early and those that were returned later. Therefore, in accordance with Armstrong and Overton (1977), significant nonresponse bias was ruled out. Whilst the sample was not perfectly balanced with the Italian population statistics, the results provided valuable evidence for consumers' preferences for sustainable products, especially amongst the young generation who represented future consumers.

The respondents were all adult consumers belonging to the 18- to 24-year-old up to the over 65 age groups. The participants took an average of 20 minutes to complete the survey.

3.2 Selection of attributes

The analysis focuses on Parma ham PDO in CEs. This product was chosen both for its typicity and its economic performance and importance in Italian and international markets. Parma ham PDO is one of the most important PDO products in Italy and Europe, with a 2020 production value of €687 million. In 2020 alone, its production reached 87.000 tonnes, with a total export value of €253 million.

In the CE, the consumers' marginal willingness to pay (mWTP) is elicited from the 'price' parameter included in the choice set together with the other attributes. The attributes used in the CE are shown in Table 2: the presence of the 'antibiotic-free' logo (AF), the presence of the PAT logo (PAT), the typology of pig breeding (AW) and the price in hg (PR).

The current research attempts to fill a gap in the literature regarding this topic by associating concerns about emissions during the first phase of Parma ham PDO production to assess consumers' mWTP for more sustainable products made with new PATs. In fact, different mitigation strategies can be applied to limit gaseous emissions from livestock. Amongst these, air cleaning systems, such as biofilters, bioscrubbers (or biotrickling filters), dry filters, two-stage or three-stage air cleaning systems, water scrubbers, water traps and wet acid scrubbers are mentioned in the Best Available Techniques (BAT) reference document for the intensive rearing of poultry or pigs (Conti et al., 2021). As an example, the wet acid scrubber, the most widely applied air cleaning technology in Northern Europe (Costantini et al., 2020) and consists of an end-of-pipe technique, is used in forced ventilated animal

houses for removing pollutants from the exhaust air. With this technology, NH_3 is captured by an acid solution, leading to the production of ammonium salt (Santonja et al., 2017).

Given that consumers are becoming more interested in the practices used to raise livestock for meat products (Innes & Cranfield, 2009; Thilmany et al., 2009), farmers must increase efficiency and effectively manage their usual practices. Consumers preferred the responsible use of antibiotics in pork meat production and, in some cases, were even willing to pay a higher premium for these products (Lusk et al., 2006). Indeed, Cervantes (2015) looked at the responsible use of antibiotics in poultry production and found that scientific evidence is lacking to support these claims. Moreover, throughout Europe, several livestock productions marked 'antibiotic-free' are growing and a niche market exists. The idea is to test consumer perceptions of a Parma ham PDO labelled 'antibiotic-free'.

In EU member states, the well-being of livestock is a serious issue for many people (Heerwagen et al., 2015; Lusk et al., 2006; Mayfield et al., 2008). For this reason, one of the current study's goals is to identify the potential market of products that have been produced with particular attention to animal welfare. Housing conditions, including outdoor access for pigs, were selected as welfare attributes because living in a natural environment with open spaces was mentioned in an earlier study as an important aspect of animal welfare (Millet et al., 2005). Although some studies (Mazzocchi & Sali, 2021; Elbakidze & Nayga, 2012; Heid & Hamm, 2013) have shown consumers' WTP for food production processes attentive to animal welfare issues, only a few scholars have investigated the issue with a focus on pork livestock (Diaz-Caro et al., 2019; Azucena-Garcia, 2016). Thus, a three-level variable related to the quality of animal welfare was included.

The fourth attribute is the price, shown in local currency (€) and formulated based on realistic prices in the Italian market. In fact, a base level is proposed to be taken from the average price of Parma ham PDO sold in large-scale retailers (e.g. Carrefour, Esselunga, Coop, Il Gigante) in Northern Italy during the interviews. This floor price, which is established as 3.4 €/hg, represents the product with the lowest level of attributes in the questionnaire and the cheapest type of ham. Similarly, the type of ham with the highest levels of the specified attributes is the most expensive, with the price fixed at 4.2 €/hg. As shown in Table 2, this means that in our example, Parma ham PDO produced using PAT, antibiotic-free and with animals given free access to outdoor fences, costs 4.2 €/hg.

3.3 Experimental design

As the base level for the survey (i.e. the benchmark on which the change is measured), the three baseline levels of the attributes were used (Figure 1). This study used four attributes, the large use of antibiotics in animals' diet, and the lack of PAT and the base level of animal welfare attribute, namely, 'pigs bred in boxes containing other animals with a per capita space of 1 m^2' (see Figure 1), as well as 3.4 €/hg as the price level. According to Caussade et al. (2005), a large number of attributes stimulate simplification practices by the participants due to cognitive constraints. Thus, to avoid misinterpretations, the descriptions of attributes and their levels were described in the questionnaire to ensure that this information was understood and accepted (Figure 1).

In a page placed before the CE, a cheap talk script was presented to the respondents. This consisted of a brief text explaining the hypothetical bias that may occur during the experiment, thus leading the respondents to reveal their real preferences (Cummings & Taylor, 1999). A Bayesian approach was also employed, which assumed a prior distribution of likely parameter values and optimised the design over that distribution rather than assuming a single fixed antecedent for each attribute (Sàndor & Wedel, 2001). A D-optimal design was generated and then used for a pilot survey of 30 respondents. The data received from this pilot survey were analysed using a multinominal logit model, and the coefficient estimates and variances for the different attributes were used as Bayesian antecedents to generate the final D-optimal design (Bliemer & Rose, 2010). This process resulted in a survey divided into two blocks with 12 choice sets each, following Caussade et al. (2005). This arrangement means that the optimal number of choice sets per individual reaches 9–16 sets. Thus, to estimate the marginal utility of the no-choice alternative in each block, the respondents were asked to make 12 choices amongst three alternatives, one of which was always the option of not buying any of the two presented products in the choice task (Figure 2). Moreover, we employed unlabelled alternatives to avoid the potential influence of brand names (Herrmann et al., 2022).

Figure 1. Descriptions of the attributes and levels

Figure 2. Choice set examples

3.4. Econometric model

The utility function used in this study is described as follows:

$$U_{njt} = ß_n' X_{njt} + E_{njt}, \qquad (1)$$

where n is the individual, j is the product, t is the choice occasion, and $ß_n$ is a vector of individual specific parameters accounting for preference heterogeneity, which is assumed to be random, except for price parameter (held fixed and included in Equation (1)). The coefficient of price is held fixed to consider a normally distributed WTP, thus avoiding a positive coefficient for price in the model results (Train, 2009; Britwum et al., 2019).

The choice probability for product j and choice set t given the parameter $ß_n$ is as follows:

$$P_{nj}(ß_n) = \exp(ß_n' X_{nj}) \,/\, \sum_j e^{ß' n X n j}, \qquad (2)$$

where jt is the number of products in choice set t. A mixed logit model (MXL) was used to analyse the CE results. The mixed logit probability is a weighted average of the logit formula evaluated at different values of ß, with weights given by the density $f(ß)$. The weighted average of several functions is called a 'mixed-function', and the density that provides the weights is called the 'mixed distribution'. The MXL model accounts for heterogeneity in preferences that are not related to the observed characteristics. It has been shown that any discrete choice random utility model can be approximated by an appropriately specified MXL model. In our study, two MXL models were presented: Model A used only the main attributes, whilst Model B employed socio-economic variables as interactions in the model, thus building interactions amongst the individual characteristics of each respondent, including

age, gender, etc., and non-monetary attributes (i.e., AF, PAT, AW1, AW2, AW3). Furthermore, the log-likelihood value (LL) was used to define the best-fitting model, including the interaction terms. The increase or decrease in LL was controlled by adding one variable term in each step of the process, thus allowing us to identify the best interactions to be included in Model B. See Model A and Model B in Table X.

The mWTP for each attribute is calculated using the following formula:

$$\text{mWTP} = -(\beta x / \beta p), \qquad (3)$$

where x= 1, 2, 3 and describes the coefficient of the three non-monetary attributes. In addition, βp represents the price attribute. To calculate the model, Stata 15 software was used, with a *mixlogit* command.

4. Results

The summary statistics are presented in Table 1. As can be seen, 55% of the sample consisted of women, while 45% consisted of male respondents. The average age value is 32 years. Respondents generally have a high level of schooling (average: 3.2 years), of whom 33% have a bachelor's degree, whilst 26% have a high school diploma. Moreover, the average of 0.4 in the PDO variable suggests that 60% of the sample chose to buy only Parma ham with the PDO brand. The biggest part of the consumers affirmed to have an annual income of less than €25,000, probably due to the fact that the sample consisted of many young people. Respondents usually buy Parma ham PDO in large-scale organised distribution stores, whilst only 4% purchased ham directly at the producer or specialty shops (17%). The respondents' level of knowledge is quite high, reaching an average value of more than 6 on a Likert scale ranging from 1 to 10.

Table 1: Descriptive statistics

Variables	Average value	Standard deviation	Observations (number)	Min	Max

Age (dummy)	32	12.04	11484	18	74
Gender (dummy: f=1)	0.55	0.5	11484	0	1
Education (from level 1=elementary school to level 5=doctoral studies)	3.24	1.02	11484	1	5
Number of family members (number)	3.53	1.24	11484	1	6
Net income in the previous year (€)	37,500	14 .02	11232	15,000	80,000
PDO row ham (dummy)	0.4	0.49	10332	0	1
Usual site of purchase (1=large scale organised distribution; 2= speciality shops; 3=in farm)	2.74	0.52	10332	1	3
Knowledge (Likert scale: 1–10)	6.16	2.12	11123	1	10

The CE results are shown in Table 2, whilst the WTP results are presented in Table 3. In Model A, only with main effects, coefficients are significant at 99%, thus confirming the quality of attribute choice, as well as the effectiveness of the experimental design and sample size. The estimated standard deviations of all attributes are statistically significant at the 99% level, suggesting that our parameters can be treated as random in the model. Thus, the significant standard deviation of beta parameters allows for observed heterogeneity.

To assess the influence of the socio-demographic characteristics of the sample on the main attribute results, several models with different interaction terms were tested using the socio-demographic features of the sample and the CE attributes. To define the best-fitting model, the log-likelihood value and the Akaike information criterion (AIC) (Table 2) were employed with a stepwise approach. Thus, we added one variable in each step and checked for an increase or decrease in the values of the two goodness-of-fit indicators. Model B (with interactions) was defined as the best-fitting model.

In Model A, the presence of the AF and PAT attributes is associated with an increase in utility. In fact, these two attributes show positive and significant coefficients, with mWTP values of 5.4 € and 5.0

€, respectively. On the contrary, the attribute ‘animal welfare’, which is characterised by three levels (AW1, AW2, AW3), results in two levels with negative coefficients: level 1 (AW1) or ‘animals bred in stables in boxes containing other animals with a per capita space of 1 m^2’ (–3.3) and ‘animals with free access to outdoor fences’ (AW3: –0.82). The negative coefficients indicate that they are not preferred choices. Similarly, the coefficients of the price (PR: –0.3) and the no-buy option (NO-BUY: –1.4) show negative signs, indicating that the respondents do not prefer these attributes.

Table 2: Estimates for the mixed logit model

Variables	Model A (main effect)	St. Dev.	Model B (with interaction)
No-buy	–1.448***		–1.355***
	(0.338)		(0.337)
Antibiotic-free (AF)	1.606***	2.107***	1.741***
	(0.140)		(0.136)
Pollutant abatement technology (PAT)	1.478***	1.744***	1.539***
	(0.131)		(0.121)
Animal welfare 1 (AW1)	–3.364***	2.784***	–3.253***
	(0.226)		(0.232)
Animal welfare 3 (AW3)	–0.821***	1.153***	–0.852***
	(0.112)		(0.150)
Price	–0.295***		–0.264***
	(0.072)		(0.072)
AF*AGE 45-54			–2.160***
			(0.496)
AST*EDU1			–0.803**
			(0.269)
AW3*KNOW			0.274**
			(0.142)
AW3*PDO			–0.289*
			(0.142)
Number of obs.	11,484		10,332
Log-likelihood	–3235.88		–3403.71
AIC	6503.76		5931.10

Notes: *p < 0.1; **p < 0.05; ***p < 0.001; Standard errors in parentheses

Model B, which is derived from the stepwise approach and is used to select interactions between the main attributes and personal characteristics, shows interesting results. Some interactions prove to be significant: AF shows a significant relation with the variables ‘age’ (AF-AGE 45–54), PAT results in a relationship with the variable ‘education’ (PAT-EDU1) and AW is related to the parameters ‘knowledge of sustainable productions’ (AW3-KNOW) and with ‘Parma ham PDO consumers’ (AW3-PDO). In particular, the AF attribute shows a negative relationship with the group of respondents whose ages range from 45–54 years. Thus, people in this age range prefer not to choose the AF attribute compared to the respondents in the other age range (coefficient: –2.1).

The second significant interaction is between the PAT variable and the group of respondents with low levels of education, mainly representing a negative relation. This means that these people prefer not to choose the attribute PAT in their purchasing decisions (–0.8). Moreover, the AW3 attribute is the preferred choice of people who have a high knowledge of agri-food chain sustainability, showing a positive and significant sign in Model B (+0.27). Finally, people who purchase only Parma ham with a PDO certification show a negative relation with AW3 (–0.29).

Table 3: Marginal willingness to pay (WTP) from the main effects mode

Variables	WTP (€)
Antibiotic-free (AF)	5.441
Pollutant abatement technology (PAT)	5.006
Animal welfare 1 (AW1)	–11.394
Animal welfare 3 (AW3)	-2.783

5. Discussion

Some considerations can be drawn from the results shown in Table 2. The use of antibiotics is one of the major concerns amongst the public regarding livestock production (Lusk, 2006; Denver et al., 2021; Grunert et al., 2018; Waluszewski et al., 2021). Our study effectively confirms consumers' preference for antibiotic-free products, as demonstrated by Model A and in accordance with the findings of Lusk et al. (2006) and Denver et al. (2021). This is a positive finding, especially in Italy, which is known for its high-quality food products, such as Parma ham PDO, with its higher added value in comparison to other pork meat products. Therefore, this represents a potential niche market for products labelled 'antibiotic-free'.

In recent years, Italian sustainable livestock production has expanded to other areas, such as the beef and poultry sectors; however, some pork supply chains still adopt these practices (Unioncamere, 2021). This can be attributed to different reasons, the first of which is the specificity of the Italian pork supply chain. In fact, this agri-food supply chain has a strongly intensive method of production, which has the highest consumption of antibiotics, along with poultry (Kirchhelle, 2018). The second reason may be due to the type of product being produced. Parma ham PDO is an Italian high-value processed meat product that, until now, commands a premium price due to its PDO certification—a strong geographical label linked to a production specification. In fact, Italy is one of the EU member states with a higher number of geographical indication-certified products, and Parma ham PDO is the top Italian meat chain product in terms of production value. Nevertheless, recent data about PDO products show a drop of –4.7% in 2019 over the previous year (Qualivita-Ismea, 2020). The implementation of a more sustainable production system can add value to Parma ham PDO. Furthermore, consumers' preference for reduced use of antibiotics in pork meat has been confirmed by Grunert et al. (2018), who

found that the reduced use of antibiotics in the pork meat production process is one of the most desired process characteristics by consumers.

Concerning the results of interactions between the presence of the 'antibiotic-free' label and the socio-demographic characteristics tested in Model B, people from the 45- to 54-year-old age group—the middle age range—do not seem to choose the 'antibiotic-free' option. The reason for this negative interaction may be the fact that people in this age range are usually workers with higher income availability compared to young people (students), making them direct purchasers of Parma ham PDO. These 'direct purchasers' may be influenced by the fact that they are not used to this type of production chain in Parma ham PDO and that they have never seen this specific product in the grocery store nor seen a brand certifying this issue. In fact, according to Nesselhauf et al. (2017), the acceptance of innovation is strengthened with an increased level of information about the innovative product. On the one hand, this product already commands a higher price compared to many other cured meat products. On the other hand, its quality is guaranteed by the PDO brand, thus exerting its communicative power in the market in a way that could stifle the potential of other brands.

As shown in the literature, the issue of animal welfare has been widely investigated (Lund et al., 2021), with studies mainly focusing on ethical concerns regarding livestock conditions and the environmental impacts of breeding. The majority of these studies found a positive consumers' WTP for production systems that care for animal welfare, considered as a better living condition for animals (Mazzocchi & Sali, 2021; Gross et al., 2021), and animal nutrition and process of production (Tonsor et al., 2009; Norwood & Lusk, 2011). The results of the current study reveal the existence of more complex conditions in which consumers do not choose the AW1 attribute (coefficient: –3.3) or the highest level of AW3 ('pigs with free access to outdoor fences', coefficient: –0.82). Indeed, they probably prefer AW2, which is maintained as the base level for the analysis in the model, as it represents the middle view amongst the three levels.

Actually, AW2 represents a better condition than the one wherein pigs live in intensive livestock systems. However, it is not the best level of breeding in which animals are reared in outdoor fences. Thus, our consumers are interested in better living conditions for pigs than the current intensive farming system, contrary to previous works on cattle, which showed consumers' WTP for the highest level of

breeding in which animals were reared in pastures (see Mazzocchi & Sali, 2018, 2021). In those studies, the consumers were only interested in allowing more space for the animals in the stable. Furthermore, in some European countries, such as Denmark or Germany, only two food labels are applied in relation to pig breeding: breeding in outdoor fences and providing extra living spaces for pigs (Lund et al., 2021). This last case well expresses the preference of the survey respondents concerning the animal welfare issue.

Two significant interactions were found in Model B between the AW attributes and other socio-demographic variables. The first interaction involves the group of respondents who only buy Parma ham with the PDO brand (PDO), showing a negative relationship with AW3. This means that consumers who only buy Parma ham with the PDO brand are not interested in purchasing other products that guarantee a high level of animal welfare for pigs during production (i.e. 'pigs with free access to outdoor fences'). This is quite interesting because it means that such consumers completely rely on the trademark of a typical geographical indication, which ensures compliance with a production specification that is a guarantee of quality in itself. Thus, for this group of consumers, the guarantee given by the PDO brand is enough for their purchasing choices, at least with regard to Parma ham PDO. As affirmed previously, in Italy, Parma ham PDO is the market leader for cured PDO products (Qualivita-Ismea, 2020).

In Model B, the second finding is the positive relation between AW3 and the knowledge variable (KNOW): the respondents who possess knowledge of sustainable production practices related to agri-food chains prefer the highest level of animal welfare in the pig livestock chain. As confirmed by many scholars, knowledge is one of the main drivers of purchasing choice (Ruggeri et al., 2020; Kim & Bohn, 2015) and choices about ethical concerns regarding food products (Mazzocchi et al., 2021).

Moreover, the PAT attribute shows a positive coefficient in Model A, indicating the existence of consumer interest in this characteristic of the pork supply chain. To the best of our knowledge, this is the first time that PAT has been proposed to consumers. Thus, this is an encouraging result, because the use of air cleaning technologies for pig housing facilities can be a novel practice in the implementation of more sustainable livestock, especially pork breeding (Costantini et al., 2020).

Until now, in terms of GHG emissions, scholars have examined consumers' sensitivity for different levels of reduction thanks to more sustainable agricultural practices that focus on products' carbon footprint levels (Van Loo et al., 2014; Grunert et al., 2018; Brunier et al., 2021; Li et al., 2016, among others). Nevertheless, the literature has yet to present a common approach to interpreting this topic. In some cases, authors have affirmed that carbon footprint levels are less appealing to consumers because the meaning of this approach is not yet well known (Van Loo et al., 2014), and they prefer buying products with other sustainable brands (Grunert et al., 2018). Others (Li et al., 2016) have found that consumers are interested in acquiring products that have been made using PAT practices.

Brunier et al. (2021) proposed the attribute of GHG as a percentage reduction of emissions in the cattle production chain, resulting in a non-significant finding. They explained this finding by saying that although governments have developed policies to reduce GHG emissions, discussions have only been conducted at the macro level and have yet to truly reach the consumers. Indeed, the current study reveals consumers' understanding of the problem, capturing their interest in this topic through the cheap talk in which we explained the different attributes at the beginning. Furthermore, in Model B, the results show a negative relation between the lowest level of scholarship and the choice of the PAT attribute. This finding confirms that education can influence consumers' environmental consciousness (Mazzocchi et al., 2021; Borec et al., 2009) in purchasing choices, thus becoming a driver of environmental food choices (Ruggeri et al., 2020).

6. Conclusion

Our results suggest consumers' interest in products labelled as 'antibiotic-free' in the Parma ham PDO chain. In Italy, this is not yet a widespread practice, especially in grocery stores where these kinds of products are very difficult to find. In fact, the Italian pork meat sector is based on an intensive breeding system that cannot easily meet market demand. Thus, the results of this study suggest the existence of a niche market for this type of production.

Similarly, the results seem to encourage the pork industry to better explore the reduction of pollutant emissions and to understand consumers' knowledge of environmental concerns in agriculture, in general, and the livestock sector, in particular. According to past studies (Brunier et al., 2021),

diffusing knowledge about this issue by using appropriate communication tools can be an appropriate marketing strategy for the agri-food sector. Moreover, information campaigns can be useful in terms of the implementation of public policies and interventions to raise public awareness of this environmental concern.

As with other studies, the current work also has some limitations. First, an online questionnaire was proposed, which cannot claim to be representative because respondents chose for themselves whether to become involved in the study. Second, qualitative research always raises doubts regarding the quality of the respondents. Even if the data are gathered and analysed by experts with the highest attention, surveys are still affected by which attributes are selected. Finally, considering, for example, that the installation and operativity of wet acid scrubbers entails an increase in production cost, verifying consumers' WTP for healthier food products, further attention should be given to the identification of the correct price that should be granted to the farmers who choose to adopt this technology.

References

Agnusdei, G.P., Coluccia, B.2022. Sustainable agrifood supply chains: Bibliometric, network and content analyses. Science of The Total Environment, 824,153704. https://doi.org/10.1016/j.scitotenv.2022.153704

Akenji, L., Bengtsson, M., 2014. Making Sustainable Consumption and Production the Core of Sustainable Development Goals. Sustainability 6. https://doi.org/10.3390/su6020513

Alfnes, F., 2004. Stated preferences for imported and hormone-treated beef: Application of a mixed logit model. European Review of Agricultural Economics 31, 19–37. https://doi.org/10.1093/erae/31.1.19

Asioli, D., Næs, T., Øvrum, A., Almli, V.L., 2016. Comparison of rating-based and choice-based conjoint analysis models. A case study based on preferences for iced coffee in Norway. Food Quality and Preference 48, 174–184. https://doi.org/10.1016/j.foodqual.2015.09.007

Armstrong, S., Overton, T., 1977. Estimating nonresponse bias in mail surveys. Journal of Marketing Research 14(3), 396–402

Bąk, A., Rybicka, A., 2005. Application of discrete choice methods in consumer preference analysis, in: Baier, D., Wernecke, K.-D. (Eds.), Innovations in classification, data science, and information systems. Springer Berlin Heidelberg, Berlin, Heidelberg, pp. 305–312.

Bazzani, C., Caputo, V., Nayga JR., R.M., Canavari, M., 2017. Testing commitment cost theory in choice experiments. Economic Inquiry 55, 383–396. https://doi.org/10.1111/ecin.12377

Bliemer, M., Rose, J., 2010. Construction of experimental designs for mixed logit models allowing for correlation across choice observations. Transportation Research Part B: Methodological 44, 720–734.

Bocken, N.M.P., Short, S.W., 2016. Towards a sufficiency-driven business model: Experiences and opportunities. Environmental Innovation and Societal Transitions 18, 41–61. https://doi.org/10.1016/j.eist.2015.07.010

Borec, A., Majkovic, D., Neve, N., 2009. How much do consumers know about mountain food products: Is there a need for labelling? In Proceedings of the Agricultural Economics and Rural Sociology, 44th Croatian & 4th International Symposium on Agriculture, Opatija, Croatia, 16–20 February 2009, 134–138.

Breidert, C., 2005. Estimation of willingness-to-pay: Theory, measurement, application. https://doi.org/10.1007/978-3-8350-9244-0

Breidert, C., Hahsler, M., Reutterer, T., 2015. A review of methods for measuring willingness-to-pay. Innovative Marketing 1.

Britwum, K., Yiannaka, A., 2019. Consumer willingness to pay for food safety interventions: The role of message framing and issue involvement. Food Policy 86, 101726

Burlingame, B., Dernini, S., 2010. Sustainable diets and biodiversity. Directions and solutions for policy, research and action. Nutrition and Consumer Protection Division FAO, Rome, Italy.

Burnier, P.C., Spers, E.E., de Barcellos, M.D., 2021. Role of sustainability attributes and occasion matters in determining consumers' beef choice. Food Quality and Preference, 88, 104075, ISSN 0950-3293, https://doi.org/10.1016/j.foodqual.2020.104075.

Burton, M., Rigby, D., Young, T., James, S., 2001. Consumer attitudes to genetically modified organisms in food in the UK. European Review of Agricultural Economics - EUR REV AGRIC ECON 28, 479–498. https://doi.org/10.1093/erae/28.4.479

Carlsson, F., Frykblom, P., Lagerkvist, C., 2007. Preferences with and without prices - Does the price attribute affect behavior in stated preference surveys? Environmental & Resource Economics 38, 155–164.

Carson, R.T., Louviere, J.J., Anderson, D.A., Bunch, D.S., Hensher, D.A., Johnson, R.M., Kuhfeld, W.F., Steinberg, D., Swait, J., Timmermans, H., Wiley, J.B., 1994. Experimental Analysis of Choice. Marketing Letters 5, 351–367.

Cassini A, Diaz Högberg L, Plachouras D, Quattrocchi A, Hoxha A, Skov Simonsen G, Colomb-Cotinat M, Kretzschmar ME, Devleesschauwer B, Cecchini M, Ait Ouakrim D, Cravo Oliveira T, Struelens MJ, Suetens S, Monnet DL, the Burden of AMR Collaborative Group, 2019. Attributable deaths and disability-adjusted life-years caused by infections with antibiotic-resistant bacteria in the EU and the European Economic Area in 2015: A population level modelling analysis. The Lancet Infectious Diseases 19, 56–66.

Cembalo, L., Caracciolo, F., Lombardi, A., Del Giudice, T., Grunert, K. L., Cicia, G., 2016. Determinants of individual attitudes toward animal welfare-friendly food products. Journal of Agricultural and Environmental Ethics 29, 237–254

Cervantes, H.M., 2015. Antibiotic-free poultry production: Is it sustainable? Journal of Applied Poultry Research 24, 91–97. https://doi.org/10.3382/japr/pfv006

Conti, C., Costantini, M., Fusi, A., Manzardo, A., Guarino, M., Bacenetti, J., 2021. Environmental impact of pig production affected by wet acid scrubber as mitigation technology. Sustainable Production and Consumption.

Costantini, M., Bacenetti, J., Coppola, G., Orsi, L., Ganzaroli, A., Guarino, M., 2020. Improvement of human health and environmental costs in the European Union by air scrubbers in intensive pig farming. Journal of Cleaner Production 275, 124007. https://doi.org/10.1016/j.jclepro.2020.124007

Caussade, J., de Dios Ortúzar, L.I., Rizzi, D.A., Hensher. 2005. Assessing the influence of design dimensions on stated choice experiment estimates. Transportation Research Part B: Methodological 39, (7), 621–640. 10.1016/j.trb.2004.07.006

De Briyne, N., Atkinson, J., Pokludová, L., Borriello, S., 2014. Antibiotics used most commonly to treat animals in Europe. Veterinary Record - Wiley 175. https://doi.org/10.1136/vr.102462

Denver, S., Jensen J.D., Christensen T., 2021. Consumer preferences for reduced antibiotic use in Danish pig production. Preventive Veterinary Medicine, 189, 105310.
Doi: 10.1016/j.prevetmed.2021.105310. Epub 2021 Feb 23. PMID: 33667759.

Denver, S., Sandøe, P., Christensen, T., 2017. Consumer preferences for pig welfare – Can the market accommodate more than one level of welfare pork? Meat Science 129, 140–146.
https://doi.org/10.1016/j.meatsci.2017.02.018

Di Vita, G., Pappalardo, G., Chinnici, G., La Via, G., D'Amico, M., 2019. Not everything has been still explored: Further thoughts on additional price for the organic wine. Journal of Cleaner Production 231, 520–528. https://doi.org/10.1016/j.jclepro.2019.05.268

Dimara, E., Skuras, D., 2005. Consumer demand for informative labeling of quality food and drink products: A European Union case study. Journal of Consumer Marketing 22, 90–100.
https://doi.org/10.1108/07363760510589253

Etilé, F., Teyssier, S., 2013. Corporate social responsibility and the economics of consumer social responsibility. Revue d'Études en Agriculture et Environnement 94, 221–259.
https://doi.org/10.4074/S1966960713012046

FAO, 2021. Food systems account for more than one third of global greenhouse gas emissions.

FAO, 2020. Statistical yearbook: World food and agriculture. FAO Statistics, Rome, Italy.

FAO, 2017. The future of food and agriculture. Trends and challanges. Food and Agriculture Organization of the United Nations, Rome, Italy.

Fischer, D., J. L. Reinermann, G., Guillen-Mandujano, C. T., DesRoches, S., Diddi, Vergragt, P. J. 2021. Sustainable consumption communication: A review of an emerging field of research. Journal of Cleaner Production 300, 126880. https://doi.org/10.1016/j.jclepro.2021.126880

Grinsven, H., van Dam, J.D., Lesschen, J., Timmers, M., Velthof, G., Lassaletta, L., 2018. Reducing external costs of nitrogen pollution by relocation of pig production between regions in the European Union. Regional Environmental Change 18, 1–13.
https://doi.org/10.1007/s10113-018-1335-5

Gross, S., Waldrop, M.E., Roosen, J., 2021. How does animal welfare taste? Combining sensory and choice experiments to evaluate willingness to pay for animal welfare pork,
Food Quality and Preference, 87, 104055, ISSN 0950-3293,
https://doi.org/10.1016/j.foodqual.2020.104055.

Grunert, K.G., 2006. Future trends and consumer lifestyles with regard to meat consumption. Meat Science - MEAT SCI 74, 149–160. https://doi.org/10.1016/j.meatsci.2006.04.016

Haase, F.V., Kohlmeyer, M., Rich, B., Woll, R., 2016. Determination of additional willingness to pay for socially responsible technical products using discrete choice analysis. Journal of Management and Sustainability 6, 45–58.

Heerwagen, L.R., Mørkbak, M.R., Denver, S., Sandøe, P., Christensen, T., 2015. The role of quality labels in market-driven animal welfare. Journal of Agricultural and Environmental Ethics 28, 67–84. https://doi.org/10.1007/s10806-014-9521

Innes, B., Cranfield, J., 2009. Consumer preference for production-derived quality: Analysing perceptions of premium chicken production methods. Agribusiness 25, 395–411.

Ismea Qualivita, 2020. Rapporto Ismea Qualivita sulle produzioni agroalimentari e vitivinicole italiane dop, igp e stg. https://www.ismea.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/11279 Accessed at 17/01/2022

Jarvis, W., Mueller, S., Chiong, K., 2010. A latent analysis of images and words in wine choice. Australasian Marketing Journal 18, 138–144. https://doi.org/10.1016/j.ausmj.2010.05.001

Kiesewetter, G., Borken-Kleefeld, J., Schöpp, W., Heyes, C., Thunis, P., Bessagnet, B., Terrenoire, E., Fagerli, H., Nyiri, A., Amann, M., 2015. Modelling street level PM10 concentrations across Europe: source apportionment and possible futures. Atmospheric Chemistry and Physics 15, 1539–1553. https://doi.org/10.5194/acp-15-1539-2015

Kim, H., Bonn, M.A. 2015. The moderating effects of overall and organic wine knowledge on consumer behavioral intention. Scandinavian Journal of Hospitality and Tourism, 15, 3, 295–310.

Kirchhelle C. 2018. Pharming animals: a global history of antibiotics in food production (1935–2017). Palgrave Communications 4, 96.

Herrmann, C., Rhein, S., Sträter, K.F., 2022. Consumers' sustainability-related perception of and willingness-to-pay for food packaging alternatives. Resources, Conservation and Recycling 181, 106219.

Lusk, J.L., Norwood, F.B., J. Ross Pruitt, 2006. Consumer demand for a ban on antibiotic drug use in pork production. American Journal of Agricultural Economics 88, 1015–1033.

Madre, Y., Devuyst, P., 2015. How will we feed the world in the next decades? An analysis of the demand and supply factors for food. Farm Europe.

Mahmoudi, H., Farajpour, M., Afrasiabi, S., 2021. The preferences of consumers for organic tea: Evidence from a stated choice experiment. Journal of the Saudi Society of Agricultural Sciences 20, 265–269. https://doi.org/10.1016/j.jssas.2021.02.006

Masson-Delmotte, V., Zhai, P., Pörtner, H.O., Roberts, D., Skea, J., Shukla, P.R., Pirani, A., Moufouma-Okia, W., Péan, C., Pidcock, R., Connors, S., 2018. Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. IPCC, Geneve.

Mayfield, L., Bennett, R., Tranter, R., Wooldridge, M., 2008. Consumption of welfare-friendly food products in Great Britain, Italy and Sweden, and how it may be influenced by consumer attitudes to,

and behaviour towards, animal welfare attributes. International Journal of Sociology of Food and Agriculture 15.

Mazzocchi, C., Orsi, L., Sali, G., 2021. Consumers' attitudes for sustainable mountain cheese. sustainability 13. https://doi.org/10.3390/su13041743

Mazzocchi, C., Sali, G., 2021. Supporting mountain agriculture through "mountain product" label: A choice experiment approach. Environmental Development and Sustainability. https://doi.org/10.1007/s10668-021-01464-3

McFadden, D., 1980. Econometric models for probabilistic choice among products. The Journal of Business 53, S13–S29.

Mekonnen, M.M., Hoekstra, A.Y., 2010. The green, blue and grey water footprint of farm animals and animal products (No. 48). UNESCO-IHE Institute for Water Education, Delft, Netherlands.

Meuwissen, M., van der Lans, I., Huirne, R.B.M., 2007. Consumer preferences for pork supply chain attributes. NJAS - Wageningen Journal of Life Sciences 54, 293–312. https://doi.org/10.1016/S1573-5214(07)80021-2

Millet, S., Moons, C., Oeckel, M., Janssens, G., 2005. Welfare, performance and meat qualify of fattening pigs in alternative housing and management systems: A review. Journal of the Science of Food and Agriculture 85. https://doi.org/10.1002/jsfa.2033

Mørkbak, M., Christensen, T., Gyrd-Hansen, D., 2010. Consumer preferences for safety characteristics in pork. British Food Journal - BR FOOD J 112, 775–791. https://doi.org/10.1108/00070701011058299

Mostafa, E., Selders, A., Buescher, W., 2019. Aeration of pig slurry affects ammonia and greenhouse gases emissions. International Journal of Environmental Science and Technology 16. https://doi.org/10.1007/s13762-019-02388-2

Nalon, E., Stevenson, P., 2019. Protection of dairy cattle in the EU: State of play and directions for Policymaking from a legal and animal advocacy perspective. Animals 9. https://doi.org/10.3390/ani9121066

Napolitano, F., Braghieri, A., Caroprese, M., Marino, R., Girolami, A., Sevi, A. 2007. Effect of information about animal welfare, expressed in terms of rearing conditions, on lamb acceptability. Meat Science 77(3), 431–436.

National Research Council, 2003. Air Emission from animal feeding operations: current knowledge, future needs. The National Academies Press, Washington, DC.

Nielsen, 2015. The sustainability imperative. New insights on consumer expectations. Verenigde Nederlandse Uitgeversbedrijven, New York.

Nesselhauf, L., Deker, J.S., Fleuchaus, R., 2017. Information and involvement: The influence on the acceptance of innovative wine packaging. International Journal of Wine Business Research, 29, 3,285-298, https://doi.org/10.1108/IJWBR-08-2016-0026

Norwood, F.B., Lusk, J.L., 2011. Compassion, by the pound: The economics of farm animal welfare. Oxford University Press.

Rosen, M.A., Kishawy, H.A., 2012. Sustainable manufacturing and design: Concepts, practices and needs. Sustainability 4. https://doi.org/10.3390/su4020154

Ruggeri G., Mazzocchi C., Corsi S., 2020. Drinking biodiversity: A choice experiment on Franciacorta sparkling wines. British Food Journal 122, 8. https://doi.org/10.1108/BFJ-06-2019-0451

Sagasta, J.M., Zadeh, S.M., Turral, H., Burke, J., 2017. Water pollution from agriculture: A global review. Food and Agriculture Organization of the United Nations - International Water Management Institute on behalf of the Water Land and Ecosystems research program, Rome, Italy.

Sahadev, S., Muralidharan, S., Singh, P., 2022. Introduction to the special issue on marketing communications and sustainability. Journal of Marketing Communications 28(3), 227–231. https://doi: 10.1080/13527266.2021.1942145

SÁndor, Z., Wedel, M., 2001. Designing conjoint choice experiments using managers' prior beliefs. Journal of Marketing Research 38, 430–444. https://doi.org/10.1509/jmkr.38.4.430.18904

Santonja, G.G., Georgitzikis, K., Scalet, B.M., Montobbio, P., Roudier, S., Sancho, L.D., 2017. Best Available Techniques (BAT) Reference Document for the Intensive Rearing of Poultry or Pigs. EUR 28674 EN.

Scarpa, R., Campbell, D., Hutchinson, W.G., 2007. Benefit estimates for landscape improvements: sequential bayesian design and respondents' rationality in a choice experiment. Land Economics 83, 617–634.

Steinfeld, H., Gerber, P., Wassenaar, T., Castel, V., Rosales, M., De Haan, C., 2006. Livestock's long shadow. Environmental issues and options. FAO, Rome, Italy.

Tait, P., Saunders, C., Dalziel, P., Rutherford, P., Driver, T., Guenther, M., 2019. Estimating wine consumer preferences for sustainability attributes: A discrete choice experiment of Californian Sauvignon blanc purchasers. Journal of Cleaner Production 233, 412–420. https://doi.org/10.1016/j.jclepro.2019.06.076

Thilmany, D., Umberger, W., Smith, A., 2009. Does altruism play a role in determining U.S. Consumer preferences and willingness to pay for natural and regionally produced beef? Agribusiness 25, 268–285. https://doi.org/10.1002/agr.20194

Thornton, P.K., 2010. Livestock production: Recent trends, future prospects. Philosophical Transactions of the Royal Society B - Journals 365, 2853–2867. https://doi.org/10.1098/rstb.2010.0134

Train, K. 2009. Discrete choice methods with simulation. U.K.: Cambridge University Press.

Unioncamere, 2021. Analisi congiunturale sull'agricoltura lombarda. http://www.unioncamerelombardia.it/images/file/OE%20Analisi%20congiuntura%202021/Report_Osservatorio_Agricoltura_I_sem_2021.pdf
Accessed at 17/01/2022

Van der Heyden, C., Demeyer, P., Volcke, E.I.P., 2015. Mitigating emissions from pig and poultry housing facilities through air scrubbers and biofilters: State-of-the-art and perspectives. Biosystems Engineering, 134, 74–93.

Verbeke, W., Perez-Cueto, F., Barcellos, M., Krystallis, A., Grunert, K.G., 2010. European Citizen and consumer attitudes and preferences regarding beef and pork. Meat Science 84, 284–292. https://doi.org/10.1016/j.meatsci.2009.05.001

Vermeir, I., Verbeke, W., 2006. Sustainable food consumption: Exploring the consumer "attitude – behavioral intention" gap. Journal of Agricultural and Environmental Ethics 19, 169–194. https://doi.org/10.1007/s10806-005-5485-3

Waluszewski, A., Cinti, A. & Perna, A, 2021. Antibiotics in pig meat production: restrictions as the odd case and overuse as normality? Experiences from Sweden and Italy. Humanities and Social Science Communication, 8, 172. https://doi.org/10.1057/s41599-021-00852-4

Wolf, C., Tonsor, G., Widmar, N., 2009. Consumer preferences for animal welfare attributes: The case of gestation crates. Journal of Agricultural and Applied Economics 41.

Xu, L., Yu, M., Chen, X., 2021. Decoy effect on consumers' purchase behaviors in relation to meat products: Comparison of pork and chicken. Frontiers in Psychology 12, 679256–679256. https://doi.org/10.3389/fpsyg.2021.679256

Zander, K., Hamm, U., 2010. Consumer preferences for additional ethical attributes of organic food. Food Quality and Preference 21, 495–503. https://doi.org/10.1016/j.foodqual.2010.01.006

Zuliani, A., Esbjerg, L., Grunert, K. G., Bovolenta, S., 2018. Animal welfare and mountain products from traditional dairy farms: How do consumers perceive complexity? Animals, 8, 207.