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Consumer preferences for wild game meat: evidence from a hybrid choice model on wild boar meat in Italy

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Abstract

The increasing numbers of wild animals in Europe is leading, on the one hand, to growing problems stemming from their interaction with human activities. On the other, many European countries have still not developed national supply chains to market wild game. Instead, these supply chains could represent a win–win strategy in providing a sustainable alternative to production via intensive livestock farming and developing rural territories. Our aim was to understand consumer behaviour towards wild game meat. We conducted a choice experiment on wild boar meat on a sample of Italian consumers (625). The application of a hybrid model combining a structural equation model and a latent class analysis allowed us to identify the antecedents of attitude towards wild game meat and to analyse consumer choices by utilising attitude as an explanatory variable. The results provide useful suggestions to implement rural development policies and offer food for thought in the area of consumer behaviour.

Keywords: Consumer behaviour, Choice experiments, Latent class analysis, Structural equation model, Wild game meat

Introduction

In recent years, the European population of wild ungulates has been growing significantly in terms of number and area covered (Acevedo et al. 2019; Ramanzin et al. 2010). There are many reasons for this, but these are mainly attributed to changes in soil use by humans and abandonment of the countryside (Acevedo et al. 2011). It is only natural that this exponential and, mainly unbridled, growth has brought conflicts between different species (Corlatti et al. 2019), and between these species and humans (Quirós-Fernández et al. 2017). Ungulates cause many instances of distress, ranging from road accidents (Pacini et al. 2020; Torzi et al. 2019; Tack et al. 2018) to crop damage (Herrero et al. 2006). Another problem worth noting is the spread of pathogens from wild animals to domestic animals (Gortazátar et al. 2016), which cause great economic damage to livestock farms (Andreoli et al. 2005).

With the increase in the animal population, also grows the number of animal killed, considering the important role that hunting plays in the control of wild species (Quirós-Fernández et al. 2017). Several European countries, like France, Spain, Austria, and

Germany, have seen the birth and growth of a thriving market based on wild game meat (Winkelmayer et al. 2008). Despite the abundance of animals and the numbers of those killed, in many other European countries, including Italy, Belgium, Finland, and Sweden, this sector has only a small market segment (Giacomelli et al. 2018; European Commission, 2014). Moreover, in some countries, like Italy, local wild game sales are limited to specialised shops and butchers, while this type of meat sold in supermarkets is almost entirely of foreign origin (Gaviglio et al. 2017; Bertolini et al. 2005). This comes as a surprise, considering that marketing local meats could bring important advantages, transforming a problem into a resource. One need only consider the marginal rural areas that would draw an economic advantage (Gaviglio et al. 2018), or the large cities that are increasingly being invaded by wild animals. The development of the national supply chain of wild game meat would be of no cost to the public and would instead be borne by hunters and by slaughterhouses that would be rewarded through demand.

In order for this supply chain to support itself, it is crucial for consumer choices to be oriented towards this type of product. The paragraph below provides a review of the literature on consumer wild game choices, followed by a research hypothesis.

The literature on consumer wild game preferences is concentrated on the tropics where wild game is an important source of protein, as shown in the review by Ingram et al. (2021) and Nasi et al. (2021). There are much fewer studies in Europe on this topic, and several recent articles (Marescotti et al. 2020, 2019; Demartini et al. 2018) seem to show the consumer's interest in game meat, but the information in this regard is still fragmented. While, in fact, the literature shows a widespread negative attitude towards hunting (Geisser et al. 2004), on the one hand, the reputation of wild game meat has been growing significantly among consumers over the past few years for the positive characteristics associated with it and its popularity (Ljung et al. 2012). Things like nutritional quality and life lived totally in the wild are the most appreciated features on the market, with an important distinction from meats that come from livestock farm animals (Bureš et al. 2015; Triumf et al. 2012; Bruckner, 2007; Hoffman et al. 2006). In particular, in contrast to intensive livestock farming, the production of wild game is more respectful of the environment and of animal welfare, (Alves et al. 2018; Thulin et al. 2015). In this regard, Hartmann et al. (2020) and Bodnar et al. (2010) noted that consumers place wild game meat and meats from extensive or organic livestock farming on the same level.

Among the main barriers to wild game meat consumption is food safety. In this regard, a recent study in Poland by Niewiadomska et al. (2020) showed that higher consumption of wild game meat is correlated with lower concerns about safety and concluded that the spread of these meats can be fostered through information campaigns aimed at reducing consumer concerns about safety. The need for more information on safety also emerged in another study conducted in Poland by Czarniecka-Skubina et al. (2022) who highlighted the presence of six clusters of wild game consumers (i.e. casual consumers, occasional game gourmets, indifferent consumers, occasional consumers, accidental consumers, and wild game lovers). The authors showed that consumers are concerned about zoonoses and microbiological contamination and argued that game meat consumption can be fostered through process certification. González et al. (2020) made similar considerations, highlighting that the danger of bacterial contamination and virus transmission from wild animals to humans can induce a negative attitude towards the

product. On the regulatory side, in Italy, the State-Regions Conference, in March 2021, established guidelines on wild boar meat hygiene (Presidency of the Council of Ministers 2021), which in a context of wide availability of wild game meat and significant consumer demand lay the foundation for the development of wild game meat supply chains.

Considering the crucial role played by demand, this study aimed to shed new light on consumer behaviour concerning the consumption of wild game meat, analysing the preferences for game by conducting a survey on wild boar meat. The analysis was implemented by applying a hybrid choice model that assessed the utility function associated with the choice of wild boar meat, incorporating the systematic heterogeneity of the preferences connected with attitude towards wild game meat. The decision to use attitude towards wild game to interpret consumer choices for a particular type of game meat was based on the analysis of the literature. We noted a strong heterogeneity of attitude towards wild game meat (Mesinger et al. 2021) and detected that it is decisive in orienting consumer preferences (Wassenaar et al. 2019; Demartini et al. 2018).

In particular, the study sought to answer the following research questions:

RQ1: is there a consumer segment interested in wild boar meat?
RQ2: does the attitude towards wild game meat impact on consumer choices about wild boar meat?
RQ3: does wild game meat process certification have a significant impact on consumer wild boar meat choices?

Materials and methods

In order to answer our research questions, we first estimated attitude towards wild boar meat through a structural equation model. Then, we developed a hybrid choice model that allowed us to incorporate attitude into the utility function associated with wild boar meat choice (Lin et al. 2019; Bazzani et al. 2017; Yangui et al. 2016; Grebitus et al. 2013; Bolduc et al. 2005; Ashok et al, 2002; Ben-Akiva et al. 1999). The following paragraphs illustrate in detail the procedure we followed.

Assessment of the attitude towards wild game meat

The attitude towards wild game meat was assessed through a structural equation model (SEM), using the antecedents that the literature indicates as important, i.e. the attitude towards animal welfare, the attitude towards hunting, age, sex, place of residence, and past behaviour. Further below we review the literature that guided us in selecting the antecedents of attitude.

Animal welfare proves fundamental when talking about food product choices. In this regard, see, by way of example, Napolitano et al. (2010) and Verbeke (2009). The main finding in the literature is that the greater the attention for animal living conditions is, the greater the interest in products that ensure respect and welfare, including the meat of wild animals that live in the wild until they are killed (Marescotti et al. 2020, 2019; Demartini et al. 2018; Tidball et al. 2014).

The importance of studying the correlation between the attitude towards hunting and the attitude towards wild game meat lies instead in the fact that there are many beliefs about hunting. On the one hand, effectiveness of hunting in controlling ungulate populations feeds into a positive attitude (Krokowska-Paluszak et al. 2020), while on the other, it is unlikely to be accepted by a part of the population due to ethical reasons (Emborg et al. 2016; Gesseir et al. 2004). These different positions could explain a different orientation towards wild game, with a positive correlation between attitude towards hunting and attitude towards wild game (Marescotti et al. 2019; Demartini et al. 2018).

In addition to the attitudes towards animal welfare and hunting, the literature shows that several sociodemographic variables can be considered antecedents of the attitude towards wild game meat. Kellert et al. (1987) underlined that men have a more positive attitude towards wildlife than women. More recently, Niewiadomska et al. (2020), Xie et al. (2020) and Marescotti et al. (2019) reached the same results, with men showing less distrust of wild meat. In the same paper, it was pointed out that young men have more concerns and worse attitudes towards wild meat. We also included place of residence in the model, given the differences found at territorial level in attitude towards wild meat (Ingram 2020). Finally, the literature shows the role of past behaviour in shaping attitude towards food in general (Çoker et al. 2020; Stranieri et al. 2017; Wong and Mullan, 2009) and wild game in particular (Wassenaar et al. 2019). We therefore included past behaviour in the model by measuring the frequency of wild game meat consumption. Figure 1 shows the model tested with the structural equation model (SEM).

The choice experiment

The preferences for wild boar meat were assessed by means of a choice experiment, drawing a comparison between a fresh wild boar sausage and pork sausage. This choice can be made because the two products can be considered as substitutes, as wild boar and pork belong to the same species, and the meat presents the same type of preservation.

The choice experiment consisted of in a hypothetical market in which the respondent was asked to imagine that they were at their usual sales outlet to purchase pork sausage

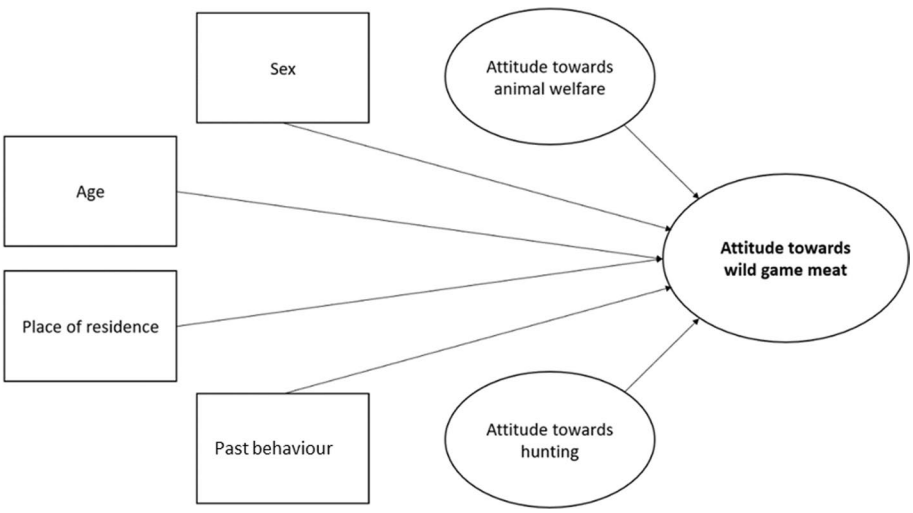

Fig. 1 Diagram of the structural equation model

and they had two alternatives: 1 kg of wild boar sausage and 1 kg of pork sausage. The respondent had to indicate which of the two options they would choose or, if neither of the alternatives was to their liking, they could opt for "No choice".

The two products differed in every purchasing scenario by the attributes and by the levels reported in Table 1.

The price intervals were selected for both alternatives based on a market survey conducted to measure the prices of the products. A price range was therefore determined for both products to comprise the range identified during the survey. The other attributes were chosen from a literature search that indicated a strong interest in origin (Balcombe et al. 2016; Dobrenova et al. 2015; Adams et al. 2010; Verbeke et al. 2006; Verbeke, 2001), and in production processes in the choice of foods (Orsoni et al. 2020; Merlino et al. 2018; Wang et al. 2018; Gaviglio et al. 2013; Verbeke et al. 2010). As for origin, the levels proposed were differentiated, taking into account the origin of the products found on the real market. We opted for this choice in order to make purchasing scenarios more realistic by offering products that indicated on the label a country of origin generally available on the shelves. For pork, we had Tuscany and Italy, highlighting the meat's local origin, followed by Germany and Spain. The two foreign origins were selected based on Italian pork imports, which see these two European countries occupying first place (ISMEA, 2019). For wild boar meat too, we utilised the origins of Tuscany and Italy. As far as imports are concerned, we instead utilised the origins of Austria and Hungary, based on the document of the European Commission (2014), concerning so-called minor meats.

As for process certification for wild game, the EC Regulations no. 178/2002, no. 852/2004, no. 853/2004, and no. 854/2004 afford wild game meat the same safety and control rules provided for domestic animals. Some specific requirements characterise wild game meat, such as the time between killing the animal and its exenteration and the rapid transportation to specialised centres for quality controls. Despite everything, a standard European labelling system has not been provided for so-called minor meats, including wild game. For this reason, we hypothesised the following statement that guarantees that meats are processed in conformity with the regulations in force: "Meat processing centre certified in accordance with European regulations". For pork, the certification used was instead organic, since it represents the most widespread process certification in Italy.

The experiment consists of 12 purchasing scenarios divided into two blocks of 6 scenarios each, obtained by means of an orthogonal design made using the software Ngene (ChoiceMetrics Ltd.). Figure 2 shows an example of a scenario.

To ensure the quality of the answers, we also included a scenario with unrealistic prices (i.e. 70 euros for pork and 75 euros for wild boar). Those who opted for either option instead of "no choice" were excluded from processing. This allowed us to improve

Table 1 Attributes and respective levels used in the choice experiment

Type of meat	Price	Origin	Process certification
Pork sausage	€16-€19-€22-€25	Tuscany-Italy-Germany-Spain	Organic
Wild Boar sausage	€19-€22-€25-€28	Tuscany-Italy-Austria-Hungary	Place of processing

Fig. 2 An example of scenario proposed in the choice experiment

the quality of the responses, as statements that respondents were willing to pay three times the average market price for a product show a lack of attention in filling out the questionnaire or lack of price knowledge. For respondents who opted for "no choice" and were therefore not excluded, the scenario with unrealistic prices was not included in the analysis.

Econometric approach

The hybrid model was conducted in two steps. The first step assessed the attitude towards wild game meat through a structural equation model (SEM) that tested the relations between attitude towards wild game meat and the following variables: (i) attitude towards hunting, (ii) attitude towards animal welfare, (iii) past behaviour, (iv) sex, (v) age, and (vi) place of residence. The second step consisted in a latent class analysis that made it possible to split the sample into homogeneous classes of preferences, estimating for each a multinomial logit model that includes the product attributes that are the subject of the choice experiment and the attitude towards wild game meat.

The specification of this model started from the random utility theory (McFadden 1974), where the utility that the individual n obtains from the alternative j is specified in Eq. 1:

$$U_{nj} = \gamma type_{nj} + \beta X_{nj} + \lambda price_{nj} + \mu No{-}buy + \varepsilon_{nj}, \quad (1)$$

where *type* represents the type of meat, γ is the effect of meat type, X_j is the vector of the attributes (i.e. origin and presence of certification), coded as dummy variables for each alternative j, β is a vector of the utilities associated with each attribute, *price* is the price vector, λ is the effect of price on utility, and *No-buy* is the no-buy option. Finally, ε_j is the unobservable error term.

Then, in the model, we included the interaction term between the meat type of our choice model ($x_j^{wild\ boar}$) and the attitude towards wild game meat ($x_j^{att.wild\ meat}$) latent construct resulting from the SEM, as specified in Eq. 2, where δ is the effect of this interaction on the utility function. The incorporation of the attitude towards wild game meat improved the explanatory power of the latent class model. Introducing

this psychographic trait enabled us to reproduce a more behaviourally realistic choice process.

$$U_{nj} = \gamma type_{nj} + \beta X_{nj} + \lambda price_{nj} + \delta\left(x_j^{wild\ boar} \cdot x_j^{att.wild\ meat}\right) + \mu No{-}buy + \varepsilon_{nj}, \tag{2}$$

$x_j^{att.wild\ meat}$ was estimated using a measurement model. In fact, although the psychographic constructs could not be directly observed, a set of k responses to the psychographic questions were functions of the psychographic trait. Therefore, we could estimate a set of equations (Eq. 3) where the values of the I_{kn} indicators were dependent on the value of a psychographic factor:

$$I_{kn} = \delta_{Ik} + \zeta_{Ik} \cdot Z_n + \upsilon_{kn} \tag{3}$$

where δ_{Ik} is a constant for the *k-th* indicator, ζ_{Ik} is the estimated effect of the latent variable Z_n on this indicator, and υ_{kn} is a normally distributed disturbance.

In our study, the SEM was estimated utilising the software STATA 15, while the latent class analysis was applied utilising the software Latent Gold Choice 4.5 (Statistical Innovation Inc.).

The case study

This paper concentrated on the wild boar, one of the most widespread large mammals in the world and in Europe (Carpio et al. 2020; Massei et al. 2015), whose exponential growth is posing many problems in various European countries (Castillo-Contreras et al. 2021; Licoppe et al. 2013). The study was based in Italy where, according to the most recent estimates, the population of wild boar has grown by 400% over the past 15 years, with about 2 million specimens (Ministero dell'Ambiente e della tutela 2017). It currently represents a major calamity for the entire peninsula (Ferri et al. 2018; Carnevali et al. 2009). In particular, the study took Tuscany as reference for the widespread presence of wild boar (Vannucci 2014), and because this region has characteristics that are representative of the whole of central and northern Italy.

The number of specimens of wild boar in Tuscany, which would be very difficult to number precisely, is undoubtedly overabundant with practically unbridled growth (Amici et al. 2018).

The study was conducted on a sample (Table 2) that appears to be representative of the Tuscan population (ISTAT 2021) as far as age is concerned, while the predominance of women can be explained by having selected the persons responsible for food purchases.

The study was conducted using a questionnaire built on Google Forms and administered in the months of January and February 2021. For recruitment, we used the city social platforms distributed over the regional territory. Participants were recruited in the surveys through quota sampling based on age.

As a result of the filter questions and of the quality control of answers that will be described further below, we obtained a sample made up of 625 individuals, starting from the 1304 respondents who began to fill out the questionnaire (Table 2).

The questionnaire was divided into four sections. The first concerned the filter questions, the second the choice experiment, and then, we recorded the attitudes towards wild game meat, animal welfare and hunting, wild game meat consumption frequency,

Table 2 Makeup of the sample collected compared to the Tuscan population

Variable	Sample (%)	Tuscan population (%)
Age		
18–34	22	21
35–54	44	34
+ 54	34	45
Sex		
Male	26	48
Female	74	52

and place of purchase. Finally, there was a section dedicated to the sociodemographic questions.

We then selected consumers of meat, responsible or co-responsible for food purchases. Furthermore, a filter was made to ensure the quality of the sample following an approach, which, to our knowledge, has never been applied before. The consumers were asked to indicate the prices of six common foods, including those of the two products subject of the choice experiment. We then selected the respondents who knew the food prices of all products. In particular, from a list ranging from € 1.00 to € 50.00 the respondents had to indicate the prices of 1 L of Tuscan extra-virgin olive oil, 1 kilo of Tuscan wood-fired oven-baked bread, 1 L of fresh whole milk, 1 kilo of Florentine T-bone steak, 1 kilo of wild boar sausage, and 1 kilo of pork sausage. The sample selection was made based on the current market prices in the various sales outlets in Tuscany. In addition to improving the quality of the sample, these questions directed the consumer's attention to the actual prices of the products and contributed to diminishing the hypothetical bias of the choice experiment.

The psychographic traits were observed by utilising the scales described in Table 3. Measuring was performed by means of five-level Likert scales.

Results

The SEM

We verified, first of all, the internal consistency between the items of the constructs utilised by means of Cronbach's alpha (Cronbach 1951). The three scores varied by 0.87 and 0.90, abundantly over the acceptability limit of 0.7 (George et al. 2003). The model was then tested by confirmatory factor analysis (CFA) to analyse reliability and the convergent and discriminant validity of the construct items. Convergent validity was assessed based on two indicators: the factor loadings and the average variance extracted (AVE). Discriminant validity was measured by comparing the AVE of each latent construct with its squared correlation (SC) with the other latent constructs of the model. If the AVE was always greater than the SC, discriminant validity was ensured. This analysis was preceded by a normality test, which proved significant. The p value of the Mardia test proved equal to 0.00, and therefore less than the maximum threshold value of 0.05. Therefore, the CFA was estimated utilising the method of the maximum verisimilitude with a Satorra–Bentler correction (Table 4).

Table 3 Items to observe the attitudes towards animal welfare, hunting, and wild game

Construct	Code	Item	Source
Attitude towards animal welfare	AW1	It is important that the food I normally eat has been produced in a way that animals have not experienced pain	Adapted from Krystallis et al. (2009)
	AW2	It is important that the food I normally eat has been produced in a way that animals' rights have been respected	
	AW3	In general humans have too little respect for the quality of life of animals	
	AW4	Increased regulation of the treatment of animals in farming is needed	
	AW5	Livestock farming raises serious ethical questions about the treatment of animals	
Attitude towards hunting	HNT1	Hunting helps keep nature in balance	Adapted from Ljung et al. (2012)
	HNT2	Most hunters are well-prepared when they go hunting	
	HNT3	I see little wrong with harvesting animals for their meat as long as the animal is not endangered	
	HNT4	Hunters are properly trained and follow hunting regulations	
	HNT5	Hunting is an important rural tradition	
Attitude towards wild game meat	WM1	It is safe to eat	Adapted from Demartini et al. (2018)
	WM2	It possesses good nutritional properties	
	WM3	It tastes good	
	WM4	Its price is fair compared to product quality	
	WM5	It is appealing	
	WM6	Its production method respects the environment	
	WM7	It is a source of income in mountainous areas	
	WM8	It is traditional	

Table 4 Convergent and discriminant validity assessment

	Construct	AVE	Squared correlation among latent variables		
			1	2	3
1	Attitude towards animal welfare	0.58	1		
2	Attitude towards hunting	0.56	0.09	1	
3	Attitude towards wild game meat	0.51	0.01	0.42	1

All of the factor loadings (Table 5) of the CFA were higher than the minimum of the recommended level of 0.6 (Chin et al. 1997). The values of the AVE (Table 4) were higher than the limit of 0.5 (Fornell et al. 1981), varying in a range between 0.51 and 0.58. It can

Table 5 Factor loadings, median, and standard deviation of the various constructs and Cronbach's alpha of scales

Construct	Code	Factor loadings	Mean	Standard deviation	Alpha
Attitude towards animal welfare	AW1	0.63	3.85	1.28	0.89
	AW2	0.67	4.05	1.16	
	AW3	0.76	3.83	1.21	
	AW4	0.87	4.20	1.13	
	AW5	0.85	3.93	1.19	
Attitude towards hunting	HNT1	0.75	2.59	1.26	0.87
	HNT2	0.73	2.49	1.22	
	HNT3	0.75	3.01	1.39	
	HNT4	0.73	2.37	1.15	
	HNT5	0.78	2.71	1.27	
Attitude towards wild game meat	WM1	0.71	2.94	1.17	0.9
	WM2	0.74	3.15	1.11	
	WM3	0.76	3.31	1.13	
	WM4	0.72	2.66	1.05	
	WM5	0.75	2.82	1.33	
	WM6	0.74	2.79	1.18	
	WM7	0.65	3.20	1.20	
	WM8	0.66	3.29	1.24	

Table 6 Antecedents of attitude towards wild game meat

Construct	Variable	Coefficient	Standard Errors
Attitude towards wild game meat	Sex	−0.14***	0.03
	Age	−0.06*	0.03
	Rural residence	0.06*	0.03
	Past behaviour	0.16***	0.04
	Attitude towards animal welfare	0.11***	0.04
	Attitude towards hunting	0.59***	0.04

*indicates a significance of 90%, **of 95% and ***of 99%

thus be affirmed that the items used attained a satisfactory convergent validity in determining the latent constructs. Finally, we observed that the values of the AVE were all higher than the SCs between the latent variables (Table 4), ensuring an adequate discriminant validity. Moreover, the model presented excellent goodness-of-fit statistics: the relationship between χ^2 and degrees of freedom was equal to 1.7 and did not exceed the threshold value of 3, the Satorra–Bentler RMSEA index (1994) was equal to 0.033, (the threshold value was 0.08) and, finally, the Satorra–Bentler CFI index was equal to 0.979, higher than the minimum threshold of 0.9 (Bentler 1990).

We then clarified the results of the structural model (Table 6), which allowed us to assess the individual score for the attitude towards wild game meat and observe what its antecedents were (sex was codified as dummy variable, male = 0 and female = 1).

We could observe that the attitude towards wild game meat was influenced by all of the variables that were hypothesised as its antecedents in the model. Young people were those who showed a more negative attitude. As for sex, males had a more positive

Table 7 Parameters characterising the three-class model utilised

Number of classes	LL	BIC	Npar	R^2
1	−3115	6301	11	0.23
2	−2847	5842	23	0.41
3	−2715	5656	35	0.49
4	−2650	5602	47	0.54
5	−2606	5592	59	0.59

LL = log likelihood, BIC = Bayesian information criterion, N. Par = number of parameters

Table 8 β value of the three classes

Attribute	Level	Class 1	Class 2	Class 3
Type of meat	Pork	0	0	0
	Wild Boar	−1.03***	0.34*	−0.24
Price (euros)		−0.5**	−0.10***	−0.39***
Origin	Tuscany (M&C)	0	0	0
	Italy (M&C)	−0.50***	0.04	−0.18
	Germany (M)	−4.49***	−1.18***	−1.16***
	Spain (M)	−4.39***	−1.59***	−1.61***
	Austria (C)	−4.22***	−1.35***	−1.41***
	Hungary (C)	−6,45***	−2.16***	−2.00***
Process certifications				
Organic certification for pork	None	0	0	0
	Available	1.59***	0.95***	0.01
Certification by wild boar processing centre	None	0	0	0
	Available	0.91***	−0.03	0.67*
Wild boar*Attitude towards wild game meat		−0.32***	0.32**	0.07
No-buy		−0.22	−4.70***	−6.06***

*indicates a significance of 90%, **of 95% and ***of 99%. Within the levels of origin M = exclusive level of origin of pork, C = exclusive level of origin of wild boar, M&C = level of origin valid for both alternatives

attitude towards wild game meat. A past behaviour characterised by more frequent consumption and residence in a rural area were also significantly and positively correlated with the construct. Finally, positive attitudes towards animal welfare and hunting led to a positive attitude towards wild game meat.

Latent class analysis

We tested several models based on different segmentation hypotheses. For each model, the information criteria for choosing the best specification were calculated (Table 7). From the analysis of the information criteria, the statistical significance of the parameters, and the meaning of the signs (Andruff et al. 2009), we chose the 3-class model.

Table 8 shows the β coefficients characterising the three classes. The first class was made up of 52% of the sample, the second of 27%, and the third of 21%.

Class 1 was made up of consumers who prefer pork. All the levels of origin proved significant and with a preference for Tuscany and, subordinately, for Italy. Both process certifications proved significant. Moreover, in this class, the utility for wild boar decreased with the increase in the attitude towards wild game meat.

The members of class 2 showed a preference for wild boar meat. The certification by the processing centre was not significant, while the presence of organic certification increased the utility of pork. As far as origin is concerned, the consumers of class 2 were concerned that the meat was of national origin. There were, in fact, no significant differences between Italy and Tuscany. Contrary to class 1, as the positive attitude towards wild game meat increased, so did utility for wild boar meat.

Class 3 was indifferent to the type of meat. Like class 2, it was important for the origin to be national, but without distinctions between Italy and Tuscany. The presence of organic certification was not significant, but the processing centre's certification was. The attitude towards wild game meat did not influence preferences for wild boar meat in this segment.

Concerning the relationship between the attitude towards wild game meat and utility for wild boar meat, it is worth noting the result obtained within class 1, where a worse attitude towards wild game meat increased the probability of choosing wild boar. We therefore decided to take a closer look at the habitual purchasing behaviour of wild boar meat, because the literature shows that these behaviours can be decisive in food choices (Çoker et al. 2020; Stranieri et al. 2017). Our hypothesis was that those who supplied themselves with wild boar meat directly from hunters, though having a more positive attitude towards wild game meat, did not choose wild boar meat because the sales point where they habitually shopped was not the place where they usually purchased wild boar meat. The results seem to confirm this hypothesis, showing that the subgroup made up of those who purchased from hunters had a more positive attitude towards wild game meat (LR chi-square = 15.34; *df* = ; $p = 0.0013$) and that this had frequencies of choice of wild boar lower than the rest of class 1 (LR chi-square = 6.34; *df* = 1; $p = 0.047$).

Discussions and conclusion

Our paper shows that attitudes towards animal welfare and hunting are antecedents of the attitude towards wild game meat. This result is coherent with the literature. In fact, though these correlations had not been directly studied yet, the papers by Marescotti et al. (2020), Marescotti et al. (2019), and Demartini et al. (2018) found that people who show a preference for wild game meat are characterised by a greater attention to animal welfare. On the other hand, though not referring directly to wild game meat, Faucitano et al. (2017) indicated that when consumers of meat show great attention to animal welfare, they tend to choose the more natural product. Our results are also in line with these statements, insofar as the correlation between the attention to animal welfare and the attitude towards wild game meat can be traced back to the fact that wild game meat is perceived as more natural compared to that of animals raised on livestock farms and therefore, as more justifiable even from a moral perspective (Hartmann et al. 2020).

Consistent with the literature, our results show that young people have a more negative attitude towards wild game meat (Niewiadomska et al. 2020; Nikolowski et al.2011; John et al. 2001). Furthermore, males have a mostly positive attitude compared to women, as also observed by Niewiadomska et al. (2020), Garrido et al. (2017), and Keller et al. (1987). The SEM also tells us that people who live in rural areas and those who consume more wild meat have a more positive attitude towards wild game meat. Therefore, our results confirm the presence of a positive correlation between past behaviour and

attitude, which was observed for foods (Wang et al. 2019; Axelson, 1986). The influence of residence in a rural area is also in line with the findings of previous studies (Duda et al. 2010; Heberlein et al. 2005). The reasons for this relationship can be traced back to factors like nearness and availability of the product (Wong et al. 2009; Verbeke et al. 2005; Bamberg et al. 2003), and familiarity (Niewiadomska et al. 2020; Marescotti et al. 2018; Borgogno et al. 2015).

Class 2 drawn from the latent class analysis shows us a segment of the population of Tuscany interested in wild boar meat. Considering that this class comprises 27% of the sample, the result is particularly important. It shows that the interest in this type of product is not marginal and thus presents good commercial potential.

Origin is confirmed as the pivotal element in consumers' choices, as shown, among others, by Carzedda et al. 2021; Eldesouky et al. 2020; Tait et al. 2019; Grunert et al. 2018. It is also worth pointing out that Tuscan origin proves more important in the class that prefers pork. In contrast, there appear to be no significant preferences between the Tuscan and Italian origins in the classes that choose wild boar. This leads us to suppose that for products of local origin from a livestock farm is an important characteristic, playing a growing role in consumer choices (Bazzani et al. 2017; Sacchi et al. 2015; Bazzani et al. 2013; Campbell et al. 2013; Adams et al. 2010; Darby et al. 2008; De Magistris et al. 2008), while wild meat of the national origin appears sufficient. It was pointed out that the foods sold on our markets are mainly imported, but data lead us to say that there is an interest among consumers for wild meat raised in their own country. Therefore, if this market sector were exploited properly, it could feed internal supply chains that would positively impact the development of rural territories.

A truly important result of our study concerns the role of process certification of wild game meat at processing centres. In fact, in classes 1 and 3 (75% of the sample), for which wild boar is not a main meat choice, this certification significantly increases the choice of this meat. The role of this certification thus appears to be fundamental when the subjects choosing are the individuals less accustomed to purchasing wild game meat. So, if certification were implemented by public decision-makers and by the competent authorities, it could prove to be a valid tool to promote the purchase of wild game meat.

Finally, our results confirm that the attitude towards wild game meat contributes to explaining the choices of wild boar meat. Let us emphasise the unexpected relationship recorded in class 1. In this class, subjects who have a more positive attitude towards wild game meat purchase it directly from hunters and therefore tend to not purchase it at traditional sales outlets. This negative correlation between attitude and preference sheds light on the importance of past behaviour in understanding consumer choices, indicating the utility of combining psychographic traits and behavioural variables in the analysis of preferences (Çoker et al. 2020; Stranieri et al. 2017).

As concerns the implications for the sector, our results support the idea of developing a wild game supply chain. Our study highlights a significant segment of consumers interested in wild game meat and that this sector could grow through the diffusion of adequate process certification systems. Moreover, we observed that attention towards animal welfare is positively correlated with the attitude towards wild game meat, and that wild game meat could therefore become an excellent alternative for meat-eaters mindful of animal welfare, a segment that is recording steady growth (Keeling et al.

2019; Buller et al. 2018). The development of a wild game meat supply chain could be a win–win strategy for the nutritional quality of meats, for the supply of a sustainable alternative to production on intensive livestock farms, for the development of rural territories, and for curbing growth in wild animal populations (Castillo-Conteraras et al. 2021). However, for all this to occur, further studies are needed on the organisation of the supply chain, and in particular on logistics, which could have major implications for the cost and quality of the meat.

This paper studied consumer preferences for wild game meat through an empirical study conducted on wild boar meat in Italy. It would be interesting to further the study of consumer behaviour concerning wild game meat, expanding the field of study to include different regions and types of meat to observe possible similarities and specific differences. Furthermore, given the importance of process certification on wild game meat choices, it would be interesting to delve into this aspect, analysing the most effective formats to further promote wild game meats and obtain greater benefits for rural areas and society as a whole.

Finally, a very interesting result is linked to the possible role of process certification in orienting preferences towards wild game meat of people who tend to choose farmed meat. This result tells decision-makers that they need to develop tools that guarantee consumers the food safety of wild game meat.

Abbreviations

AVE	Average variance correlation
CFA	Confirmatory factor analysis
EC	European Commission
SC	Squared correlation
SEM	Structural equation model

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Author contributions
T.F. contributed to investigation, data curation, methodology, and writing. C.C. was involved in conceptualisation, writing, reviewing, and editing. G.S. contributed to reviewing. L.C. was involved in reviewing and supervision. All authors read and approved the final manuscript.

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Declarations

Competing interests
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