



Attitudes and beliefs of Eastern European consumers towards piglet castration and meat from castrated pigs

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ABSTRACT

Castration of male piglets is a common practice to avoid boar taint but is being questioned. The present work has an exploratory character and aims to investigate the beliefs and attitudes of Eastern European consumers regarding boar taint, surgical castration immunocastration and perception of meat from castrated pigs and to find out possible segments of consumers regarding these attitudes and beliefs. For this purpose, a consumer study was carried out involving 5508 consumers from 13 Eastern European countries (Bosnia and Herzegovina, Bulgaria, Czech Republic, Croatia, North Macedonia, Hungary, Moldova, Poland, Romania, Serbia, Slovakia, Slovenia and Ukraine). The questionnaire included statements related to beliefs about castration and perception of meat from castrated pigs, attitudes towards meat from castrated pigs. Results show that in general beliefs and attitudes of the consumers are not defined, probably because of the lack of knowledge (information was not provided to the consumers) towards these issues. Three different clusters of consumers were obtained with different beliefs towards castration.

1. Introduction

Castration of male piglets is a common practice in pig husbandry performed to avoid boar taint, an offensive odour connected mainly with the presence of skatole and androstenone (Claus, Weiler, & Herzog, 1994; Patterson, 1968) that can be perceived during the cooking and/or heating of pork from entire or uncastrated male pigs. In Europe, the majority of piglets are castrated surgically without any anaesthesia or post-operative analgesia, which is allowed by European legislation up to an age of 7 days (Council Directive 2008/120/EC).

Castration is a painful and stressful procedure (Marchant-Forde et al., 2009) and recognized as a considerable animal welfare problem. If the pigs are not given both anaesthesia and analgesia for castration, it is unlikely that their welfare will be substantially improved, and preferably it should be avoided in favour of other practices (FVE, 2009).

What is the European pork industry doing to address this important animal welfare issue? In 2010 the European pork chain stakeholders signed a voluntary agreement known as “Brussels Declaration” on alternatives to surgical castration. The aim of the declaration was to eliminate the surgical castration of pigs without pain relief by 2012 and

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to phase out surgical castration by 2018. The deadline ended officially on 1 January 2018 and the European pork chain is still resisting the change and has not yet widely adopted more welfare friendly alternatives, such as surgical castration with anaesthesia/analgesia, rearing entire males (boars) or vaccination against GnRH to prevent boar taint. From 2012 up to now, some European countries apply anaesthesia before surgical castration but it is not an extended practice.

In this context, it is necessary to know if meat consumers would be willing to accept the change from castrated pig meat to meat from entire males, in order to evaluate whether commercialization of boar meat would be a problem on a particular market (Borrisser-Pairó et al., 2016). Numerous consumer related studies regarding boar taint and castration issues have been reported in the past, and they can be divided into two groups. The first group is about consumer sensory acceptability of boar taint, encompassing > 50 different trials carried out in 15 countries until 2012 (Font-i-Furnols, 2012) none of them situated in Eastern Europe. The second group is about consumers' attitudes towards surgical castration and its alternatives and so far this subject has been investigated in some countries individually: Belgium (Tuytens et al., 2011; van Beirendonck, Driessen, & Geers, 2013; Vanhonacker, Verbeke, & Tuytens, 2009), Germany (Heid & Hamm, 2012), Norway (Fredriksen, Johnsen, & Skuterud, 2011), Spain (Kallas et al., 2013), Sweden (Lagerkvist, Carlsson, & Viske, 2006) and Switzerland (Huber-Eicher & Spring, 2008) or as a multinational surveys (Kallas et al., 2012; Vanhonacker & Verbeke, 2011). However, neither of the countries involved was Eastern European. In some of these studies immunocastrated were preferred to surgically castrated (Lagerkvist et al., 2006; Vanhoacker et al., 2009; Vanhoacker & Verbeke, 2011) and this better than entire males (Lagerkvist et al., 2006) specially when informed (Tuytens et al., 2011). On the other hand, some consumers were sceptic about immunocastration (Fredriksen et al., 2011) or consider immunocastration less favourable than surgical castration with anaesthesia (Huber-Eicher & Spring, 2008). For consumers of organic products, surgical castration with anaesthesia was the most favourable option, followed by entire male, immunocastration and surgically castration without anaesthesia (Heid & Hamm, 2012). In most of the studies information was provided to the consumers but the type and amount of information is different and, it can affect at the consumers' answer (Tuytens et al., 2011).

Because of the high discrepancy in public interest in farm animal welfare and ethical issues across European countries (Vanhonacker et al., 2009), a generalisation of findings from Western European consumer studies to Eastern European countries would be quite speculative and questionable. Even more so because a general insight into Eastern European meat consumers' perceptions and behaviour is largely unavailable (Font-i-Furnols & Guerrero, 2014), except for a few studies published recently (Skunca et al., 2017; Tomasevic et al., 2018).

The process of selecting and buying a certain food is a complex phenomenon that is usually influenced by other aspects in addition to the sensory characteristics or the price (Font-i-Furnols & Guerrero, 2014). There are numerous studies that demonstrate the importance of psychological factors (attitudes and values, for example) in the behaviour of consumers in relation to a particular food (Shepherd, 1988; Axelson & Brinberg, 1989; Stafleu, Graaf, & Staveren, 1991/2). In most of these studies, models are used to examine the relationship between individual beliefs, attitudes and behaviour; they are called choice models. These models are based on the idea that consumer behaviour is determined by a process of voluntary control, that is, of conscious beliefs and attitudes, and not by habit or unconscious processes (Axelson & Brinberg, 1989). There are numerous socio-psychological models described in the scientific literature, although probably the most commonly used to measure food-related behaviour is the Reasoned Action model of Fishbein and Ajzen (1975). All the components of this model have received a rigorous psychometric check, being especially useful in predicting food behaviour (for more details on this model see the review made by Ajzen, 1991). Two key elements of these models are

beliefs and attitude, which are usually those that predict a greater part of individual behaviour or behavioural intention (Guàrdia, Guerrero, Gelabert, Gou, & Arnau, 2006).

The aim of this research was to investigate the beliefs and attitudes of Eastern European consumers regarding boar taint, surgical castration, immunocastration and perception of meat from castrated pigs, and to observe possible differences with their Western European counterparts. This is a key issue to be considered by the European legislators and meat industry when taking actions related to castration issue. Any insight into consumers' beliefs and attitudes is important, because we can expect them to be antecedents of behavioural intentions (Vanhonacker et al., 2009). Therefore, the additional aim of this research was to identify segments of Eastern European consumers with related beliefs and attitudes about castration and perception of meat from castrated pigs.

2. Materials and methods

2.1. Consumers and questionnaire

The field survey on consumers' attitudes and beliefs about castration and perception of meat from castrated pigs has been conducted during 2017 using a questionnaire directed at 5508 consumers of 13 Eastern European countries (Bosnia and Herzegovina, Bulgaria, Czech Republic, Croatia, North Macedonia, Hungary, Moldova, Poland, Romania, Serbia, Slovakia, Slovenia and Ukraine). The recruitment of the consumers was done through an existing network of professional and family acquaintances in an extended way, by further dissemination of the questionnaire through their networks. In countries where a larger number of respondents were needed, the interviews were also conducted at points of sale like butcher shops and meat markets. Participants were not economically rewarded. In order to maximize the representativeness of the data for the overall population, the selected number of consumers was weighted per country to reflect the population demographics in terms of age, gender and population (with a minimum of 200 consumers selected by country). The characteristics of the consumers recruited are presented in Table 1.

A structured questionnaire was developed including 8 statements (beliefs) about castration and perception of meat from castrated pigs. Respondents had to indicate their degree of agreement for each statement according to a seven-point Likert scale from 1 "disagree very strongly", 2 "disagree strongly", 3 "disagree", 4 "neither agree nor disagree", 5 "agree", 6 "agree strongly" to 7 "Agree very strongly" (Tables 2 and 3). The questionnaire also had 5 statements regarding consumers' attitude towards castration and towards meat from castrated pigs. Different seven-point scales were used including the following adjectives: 1 "harmful" - 7 "beneficial"; 1 "easy" - 7 "difficult"; 1 "bad" - 7 "good" and 1 "natural" - 7 "artificial" (Tables 4 and 5). The beliefs to be evaluated as well as the adjectives selected to measure the attitude were obtained from a previous qualitative research in which different focus groups were held (Claret, Guerrero, Rodríguez, and Dalmau (2012). Both were selected and evaluated following to the recommendations of Ajzen and Fishbein (1980). Furthermore, a statement about willingness to pay a little more for the meat from castrated pigs was also included (Tables 2 and 3). All questions were randomly mixed to obtain the final questionnaire to be answered by the participants. In the end, general demographic information about participants and frequency of consumption of pork, chicken, lamb and beef meat was also obtained to better characterize the consumers that participate in the study. Also information about their place of growing up (rural or urban) and educational level was recorded.

2.2. Statistical analysis

For each described item (8 beliefs, 5 attitude assessment and one item about willingness to pay) analysis of variance was performed. The

Table 1
Demographic profile and frequencies (%) of meat consumption of the sample of consumers that participate in the study by country^a (n = 5508).

| (%) | Overall | BIH (n = 324) | BGR (n = 352) | CZE (n = 510) | HRV (n = 301) | MKD (n = 285) | HUN (n = 400) | MDA (n = 300) | POL (n = 504) | ROU (n = 557) | SRB (n = 678) | SVK (n = 301) | SVN (n = 246) | UKR (n = 750) |
|--------------------------------------|---------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| Gender | | | | | | | | | | | | | | |
| Male | 44.7 | 51.6 | 40.9 | 38.6 | 39.5 | 48.1 | 56.0 | 31.3 | 48.6 | 49.7 | 47.8 | 39.9 | 45.0 | 40.3 |
| Female | 55.3 | 48.4 | 59.1 | 61.4 | 60.5 | 51.9 | 44.0 | 68.7 | 51.4 | 50.3 | 52.2 | 60.1 | 55.0 | 59.7 |
| Age | | | | | | | | | | | | | | |
| < 36 | 39.4 | 27.2 | 19.3 | 46.3 | 35.2 | 36.5 | 47.0 | 63.0 | 50.0 | 46.7 | 36.0 | 33.6 | 48.1 | 29.2 |
| 36–55 | 32.9 | 44.8 | 48.0 | 24.1 | 28.9 | 34.7 | 36.3 | 22.7 | 17.9 | 28.7 | 38.0 | 37.9 | 31.8 | 37.1 |
| Above 55 | 27.6 | 28.1 | 32.7 | 29.6 | 35.9 | 28.8 | 16.8 | 14.3 | 32.1 | 24.6 | 26.0 | 28.6 | 20.2 | 33.7 |
| Education level | | | | | | | | | | | | | | |
| Elementary | 5.4 | 9.2 | 4.3 | 2.4 | 11.3 | 7.4 | 1.0 | 3.7 | 1.0 | 10.4 | 10.3 | 5.3 | 5.8 | 1.1 |
| Higher | 42.1 | 68.5 | 54.0 | 54.9 | 33.9 | 53.2 | 40.0 | 45.5 | 26.2 | 44.3 | 62.4 | 46.3 | 36.3 | 7.1 |
| University | 52.5 | 22.3 | 41.8 | 42.7 | 54.8 | 39.4 | 59.0 | 50.8 | 72.8 | 45.2 | 27.3 | 48.3 | 57.9 | 91.9 |
| Household members | | | | | | | | | | | | | | |
| One | 5.9 | 6.1 | 4.9 | 11.6 | 6.0 | 4.2 | 1.3 | 5.4 | 7.9 | 7.7 | 5.1 | 7.7 | 4.6 | 3.2 |
| Two/three | 48.1 | 50.0 | 68.6 | 55.5 | 43.9 | 24.3 | 31.1 | 40.1 | 35.5 | 60.5 | 46.3 | 48.3 | 40.0 | 59.7 |
| Four/five | 40.8 | 43.9 | 26.6 | 28.8 | 42.5 | 62.3 | 59.1 | 45.5 | 47.8 | 30.0 | 43.4 | 35.7 | 43.3 | 35.9 |
| > Five | 5.2 | 0.0 | 0.0 | 4.1 | 7.6 | 9.2 | 8.5 | 9.1 | 8.7 | 1.8 | 5.1 | 8.3 | 12.1 | 1.2 |
| Place of growing up | | | | | | | | | | | | | | |
| Rural | 59.6 | 96.6 | 34.1 | 57.8 | 61.8 | 42.8 | 60.3 | 57.0 | 60.7 | 52.1 | 80.4 | 57.0 | 81.7 | 43.1 |
| Urban | 40.4 | 3.4 | 65.9 | 42.2 | 38.2 | 57.2 | 39.8 | 43.0 | 39.3 | 47.9 | 19.6 | 43.0 | 18.3 | 56.9 |
| Frequency of pork consumption | | | | | | | | | | | | | | |
| Daily | 20.3 | 36.3 | 12.0 | 14.5 | 12.0 | 15.1 | 8.0 | 54.3 | 25.4 | 18.0 | 29.7 | 14.3 | 13.1 | 14.1 |
| Weekly | 21.1 | 23.3 | 18.6 | 21.4 | 13.3 | 22.1 | 11.3 | 18.3 | 29.4 | 26.2 | 18.1 | 24.0 | 13.5 | 24.9 |
| Fortnightly | 43.3 | 26.2 | 57.1 | 56.1 | 58.5 | 46.0 | 55.0 | 19.0 | 32.7 | 42.2 | 26.7 | 50.0 | 57.0 | 47.4 |
| Monthly | 10.2 | 6.9 | 4.9 | 3.3 | 14.0 | 12.6 | 24.0 | 4.0 | 4.0 | 6.3 | 17.5 | 8.3 | 12.7 | 12.2 |
| Never | 5.1 | 7.3 | 7.4 | 4.7 | 2.3 | 4.2 | 1.8 | 4.3 | 8.5 | 7.4 | 8.1 | 3.3 | 3.7 | 1.5 |

^a BIH: Bosnia and Herzegovina; BGR: Bulgaria; CZE: Czech Republic; HRV: Croatia; MKD: North Macedonia; HUN: Hungary; MDA: Moldova; POL: Poland; ROU: Romania; SRB: Serbia; SVK: Slovakia; SVN: Slovenia; UKR: Ukraine.

Table 2
Effect of demographic characteristics on the believes of Eastern European consumers about castration and meat from castrated pigs¹.

| | Gender | | | Age | | | Education level | | | Growing place | | | RMSE |
|---|---------|------------------|------------------|------------------|------------------|------------------|--------------------|------------------|------------------|------------------|------------------|-----|------|
| | Overall | Men | Women | < 36 | 36–55 | > 55 | Elementary | High | University | Urban | Rural | | |
| <i>Beliefs about castration</i> | | | | | | | | | | | | | |
| The surgical castration produces pain to the animal | 4.9 | 4.9 ^b | 5.0 ^a | 4.9 | 5.0 | 4.9 | 4.9 | 4.9 | 4.9 | 5.0 ^a | 4.8 ^b | 1.4 | |
| The castration is not necessary | 3.7 | 3.6 | 3.7 | 3.7 | 3.7 | 3.6 | 3.6 | 3.7 | 3.7 | 3.7 ^a | 3.6 ^b | 1.4 | |
| The surgical castration is savage | 4.0 | 3.8 ^b | 4.0 ^a | 3.8 ^b | 3.9 ^b | 4.0 ^a | 3.8 | 3.9 | 4.0 | 4.0 ^a | 3.8 ^b | 1.5 | |
| <i>Beliefs and preferences about meat quality from castrated pigs</i> | | | | | | | | | | | | | |
| I prefer to eat meat from castrated pigs | 4.5 | 4.5 | 4.6 | 4.4 ^b | 4.5 ^a | 4.6 ^a | 4.5 | 4.5 | 4.6 | 4.5 | 4.6 | 1.4 | |
| Meat from castrated pigs is of better quality | 4.7 | 4.6 | 4.7 | 4.5 ^b | 4.7 ^a | 4.7 ^a | 4.5 ^b | 4.6 ^b | 4.8 ^a | 4.6 ^b | 4.7 ^a | 1.4 | |
| Meat from castrated pigs is leaner | 3.8 | 3.8 ^b | 3.9 ^a | 3.9 ^a | 3.7 ^b | 3.9 ^a | 3.8 | 3.8 | 3.8 | 3.9 ^a | 3.7 ^b | 1.2 | |
| The meat from castrated pigs is more expensive | 3.9 | 3.8 ^b | 3.9 ^a | 3.9 ^a | 3.8 ^b | 3.9 ^a | 3.8 ^{a,b} | 3.8 ^a | 3.9 ^b | 3.9 | 3.9 | 1.2 | |
| Pig castration with vaccines improves pork quality | 3.7 | 3.6 ^b | 3.7 ^a | 3.7 | 3.7 | 3.7 | 3.6 | 3.7 | 3.7 | 3.7 | 3.7 | 1.3 | |
| <i>Willingness to pay</i> | | | | | | | | | | | | | |
| I am willing to pay a little more for meat from castrated pigs | 4.1 | 4.0 | 4.0 | 4.0 ^b | 3.9 ^b | 4.2 ^a | 4.0 | 4.0 | 4.1 | 4.0 | 4.0 | 1.5 | |

Scale: (1) - Disagree very strongly; (2) - Disagree strongly; (3) - Disagree; (4) - Neither agree nor disagree; (5) - Agree; (6) - Agree strongly; (7) - Agree very strongly.
¹ Items in the same row and within classification category with different superscripts are significantly different ($P < .05$); RMSE: root-mean-square error.

model included gender, age group, education, growing place or country as fixed effects. A Post Hoc test for multiple comparisons of least square mean values was performed with Tukey's HSD test. Due to the lack of normality of the data a previous analysis using the non-parametric Kruskal-Wallis test was performed. Since similar results were obtained, the parametric analyses were kept as suggested by O'Mahony (1986). In order to identify segments of consumers with similar beliefs and attitude patterns, an Agglomerative Hierarchical Cluster Analysis was conducted (Ward method and Euclidian distance). The final number of clusters to retain was based on the percentage of within-cluster variance drop when adding a new cluster. The validity of the identified segments was checked by means of a Discriminant Analysis and their corresponding confusion matrix. All the statistical analyses were carried out with the software XLSTAT, version 2017 (Addinssoft, Paris).

3. Results and discussion

3.1. Demographic profile and frequency of pork meat consumption

Overall, the demographic profile of 5508 respondents from 13 Eastern European countries (Table 1) showed that the female population was slightly prevailing (55.3%). There were differences in that respect between countries; Moldova was the country with the highest proportion of women (68.7%) whereas the countries with the lowest

proportion were Bosnia and Herzegovina (48.4% female) and Hungary (44.0% female). Distribution regarding the respondent's age revealed that the group of consumers who were younger than 36 years of life was most represented, with more than a third (39.4%) of the sample surveyed, varying from 19.3% in Bosnia and Herzegovina to 63.0% in Moldova. Population older than 55 years was on average 27.6%, varying from 14.3% in Moldova to 35.9% in Croatia. Only a fraction of consumers (5.4% on average, varying from 1% in Hungary and Poland to 11.3% in Croatia) had an only elementary education. The highest percentage in Croatia and Serbia might be due to the higher number of young consumers that have not finished high school yet. The majority of the consumers had a university degree diploma (52.5% on average, varying from 22.3% in Bosnia and Herzegovina and 91.9% in Ukraine). Most of the consumers (59.6%) consider being grown up in rural areas, being this proportion from 34.1% in Bulgaria to 96.6% in Bosnia and Herzegovina. Largest share of the Eastern European consumers eat pork on fortnightly basis (43.3% on average and varying from 19.0% in Moldova to 58.5% in Croatia) with almost equal share of them eating pork on weekly (21.1% on average and varying from 11.3% in Hungary and 29.4% in Poland) and daily (20.3% on average and varying from 8.0% in Hungary and 54.3% in Moldova) basis. This sociodemographic picture points out the bias in sampling due to convenience sampling used. Supplementary material S1 shows the real bias between the selected sample and the official distribution. Thus, it can be considered

Table 3
Effect of the country on the believes of Eastern European consumers about castration and meat from castrated pigs¹.

| | Country ² | | | | | | | | | | | | RMSE | |
|---|----------------------|-------------------|--------------------|--------------------|--------------------|------------------|-------------------|--------------------|--------------------|-------------------|--------------------|---------------------|-------------------|-----|
| | BIH | BGR | CZE | HRV | MKD | HUN | MDA | POL | ROU | SRB | SVK | SVN | | UKR |
| <i>Beliefs about castration</i> | | | | | | | | | | | | | | |
| The surgical castration produces pain to the animal | 5.0 ^{bc} | 5.6 ^a | 4.7 ^{def} | 5.0 ^{bcd} | 5.2 ^b | 4.2 ^g | 5.1 ^{bc} | 4.5 ^{efg} | 4.8 ^{cde} | 5.2 ^b | 4.4 ^{fg} | 4.7 ^{cdef} | 5.2 ^b | 1.4 |
| The castration is not necessary | 4.9 ^a | 2.6 ^{gh} | 3.7 ^{cd} | 4.1 ^b | 3.6 ^{de} | 2.3 ^h | 3.2 ^{ef} | 4.2 ^b | 2.9 ^{fg} | 4.7 ^a | 3.9 ^{bcd} | 4.1 ^{bc} | 3.4 ^e | 1.4 |
| The surgical castration is savage | 4.7 ^a | 3.3 ^f | 3.8 ^e | 4.1 ^{cde} | 4.4 ^{bc} | 2.4 ^g | 3.9 ^{de} | 4.2 ^{cd} | 3.3 ^f | 4.7 ^a | 3.9 ^e | 3.8 ^e | 4.3 ^c | 1.5 |
| <i>Beliefs and preferences about meat quality from castrated pigs</i> | | | | | | | | | | | | | | |
| I prefer to eat meat from castrated pigs | 3.7 ^b | 5.7 ^a | 4.3 ^e | 4.3 ^{ef} | 4.4 ^{de} | 5.6 ^a | 4.7 ^{cd} | 3.8 ^{gh} | 5.1 ^b | 4.0 ^{fg} | 4.0 ^{fgh} | 4.5 ^{de} | 4.9 ^{bc} | 1.4 |
| Meat from castrated pigs is of better quality | 4.5 ^{de} | 3.6 ^f | 4.4 ^e | 4.5 ^{de} | 4.8 ^{cd} | 5.6 ^a | 5.0 ^{bc} | 3.8 ^f | 5.2 ^b | 4.6 ^{de} | 4.3 ^e | 4.8 ^{cd} | 5.0 ^{bc} | 1.4 |
| Meat from castrated pigs is leaner | 3.7 ^{bcd} | 5.3 ^a | 3.7 ^{cd} | 3.7 ^d | 4.0 ^b | 3.6 ^d | 3.5 ^d | 4.0 ^{bc} | 3.7 ^d | 3.7 ^d | 3.6 ^d | 3.4 ^d | 3.7 ^d | 1.4 |
| The meat from castrated pigs is more expensive | 4.5 ^a | 3.3 ^d | 3.5 ^d | 3.8 ^{cd} | 3.9 ^c | 3.3 ^d | 4.2 ^{bc} | 4.2 ^{bc} | 4.1 ^{bc} | 4.3 ^{ab} | 3.7 ^e | 3.5 ^{cd} | 4.0 ^{bc} | 1.2 |
| Pig castration with vaccines improves pork quality | 4.1 ^{ab} | 3.0 ^d | 3.5 ^c | 3.6 ^c | 4.0 ^{ab} | 2.6 ^e | 4.2 ^a | 4.0 ^{ab} | 3.9 ^b | 3.9 ^b | 3.5 ^c | 3.8 ^{bc} | 3.6 ^c | 1.3 |
| <i>Willingness to pay</i> | | | | | | | | | | | | | | |
| I am willing to pay a little more for meat from castrated pigs | 4.0 ^{bcd} | 2.9 ^f | 3.8 ^{de} | 4.0 ^{bcd} | 4.2 ^{abc} | 4.5 ^a | 4.3 ^{ab} | 3.9 ^{cde} | 4.6 ^a | 4.1 ^{bc} | 3.6 ^e | 4.0 ^{bcd} | 4.4 ^a | 1.5 |

¹ Items in the same row and within classification category with different superscripts are significantly different ($P < .05$); RMSE: root-mean-square error. Scale: (1) - Disagree very strongly; (2) - Disagree strongly; (3) - Disagree; (4) - Neither agree nor disagree; (5) - Agree; (6) - Agree strongly; (7) - Agree very strongly.

² BIH: Bosnia and Herzegovina; BGR: Bulgaria; CZE: Czech Republic; HRV: Croatia; MKD: North Macedonia; HUN: Hungary; MDA: Moldova; POL: Poland; ROU: Romania; SRB: Serbia; SVK: Slovakia; SVN: Slovenia; UKR: Ukraine.

Table 4
Effect of the demographic characteristics of the Eastern European consumers on their attitudes towards castration¹.

| | Gender | | | Age | | | Education level | | | Growing place | | |
|--|---------|------------------|------------------|------------------|------------------|------------------|-----------------|------|------------|------------------|------------------|------|
| | Overall | Men | Women | < 36 | 36–55 | > 55 | Elementary | High | University | Urban | Rural | RMSE |
| I think that surgical castration of pigs is... <i>1: Harmful; 4: Neither ... nor ...; 7: Beneficial</i> | 4.6 | 4.6 ^a | 4.5 ^b | 4.5 ^b | 4.6 ^b | 4.7 ^a | 4.5 | 4.6 | 4.7 | 4.5 ^b | 4.7 ^a | 1.8 |
| In my opinion, surgical castration of pigs is... <i>1: Easy; 4: Neither ... nor ...; 7: Difficult</i> | 4.0 | 3.8 ^b | 4.0 ^a | 3.9 | 3.9 | 3.9 | 3.8 | 3.9 | 3.9 | 4.0 ^a | 3.8 ^b | 1.8 |
| The surgical castration of pigs is... <i>1: Bad; 4: Neither ... nor ...; 7: Good</i> | 4.5 | 4.7 ^a | 4.5 ^b | 4.5 | 4.6 | 4.6 | 4.6 | 4.6 | 4.5 | 4.4 ^b | 4.7 ^a | 1.8 |
| I believe that castrating pigs is something... <i>1: Natural; 4: Neither... nor ...; 7: Artificial</i> | 4.5 | 4.3 | 4.3 | 4.6 ^a | 4.3 ^b | 3.9 ^c | 4.2 | 4.2 | 4.3 | 4.5 ^a | 4.1 ^b | 2.0 |
| Pig castration with vaccines is: <i>1: Bad; 4: Neither ... nor ...; 7: Good</i> | 3.8 | 3.7 ^b | 3.9 ^a | 3.9 ^a | 3.8 ^b | 3.7 ^b | 3.8 | 3.8 | 3.8 | 3.9 ^a | 3.7 ^b | 1.9 |

¹ Items in the same row and within classification category with different superscripts are significantly different (P < .05); RMSE: root-mean-square error.

that the results shown in the present study have rather an exploratory character. Convenience sampling can be an appropriate approach when the researcher is interested in getting an inexpensive approximation to a specific topic by involving the participants who meet specific recruitment criteria with relevance for the subject under investigation (Guerrero et al., 2010). Thus, the results shown in the present study should be regarded as an exploratory approximation.

3.2. Beliefs about surgical castration and castration using vaccines (immunocastration)

In this work, no information was previously given to consumers. Thus, it can be assumed that some consumers were not familiar with castration as general production practice nor the problem of boar taint. In fact, in a study with 4031 consumers from Belgium, France, Germany and the Netherlands showed that on average 48.5% of them never heard about physical castration and 53.7% of the consumers never heard about boar taint (Vanhonacker & Verbeke, 2011). In Poland, a country with an important pig production, a study show that castration raises social opposition, especially when performed without anaesthesia (Skrzypczak, Szulc, Zaworska, & Panek, 2011). This situation in the rest of the Eastern countries studied is not known but probably is similar. This is a limitation of the study since it can affect the answer of the consumers, but on the other side, it reflects the beliefs and attitudes in the real situation, without added information.

The effects of gender, age, education, growing place and country of origin on the beliefs of Eastern European consumers towards castration are presented in Tables 2 and 3.

When Eastern European consumers were asked if they believed that surgical castration produces pain to the animals, they agreed with the statement (average score 4.9). The difference between men (4.9) and

women (5.0) and consumers that grew up in urban (5.0) and rural areas (4.8), although significant, is quite irrelevant. In all cases, mean values fell within the classification category ‘agree’ (Table 2). When looking across countries, some differences were observed. Hungarian consumers, had significantly the lowest score (4.2) and were the only ones that answered on average ‘neither agree nor disagree’. Bulgarian consumers had significantly the highest average score (5.6) and were the only ones that answered on average ‘agree strongly’ (Table 3).

On average, the Eastern European consumers had not clear opinion regarding the statement that castration is not necessary (overall mean value 3.7, Table 3). This may indicate that people do not know about the practice. No effect of demographics was observed, with the sole exception of the growing place, which again, although significant, was irrelevant. However, important differences were observed between countries. The Hungarian rates about this statement were on average ‘disagree strongly’ (2.4) and those from Bulgarian (2.6), Romanian (2.9), Moldovian (3.2) and Ukrainian (3.4) consumers were on average ‘disagree’. This belief agrees with the results of Norwegian study in which consumers proclaimed castration as a necessary procedure with only minor doubts (Fredriksen et al., 2011). However, in the Norwegian study, consumers received information about castration, how it is performed, consequences of not performing the castration and its alternatives. In the present study no information was provided to the consumers about castration. The type of information given to consumers may influence their opinion (Mancini, Menozzi, & Arfini, 2017; Tuytens et al., 2011). Only the Serbian (4.7) and Bosnian and Herzegovinian (4.9) consumers' belief was in the opposite direction (Table 3). Perhaps differences in attitudes towards animal welfare could help to explain these observed differences between countries. It would be interesting to know if there are differences in the level of knowledge about castration in different countries because this could affect the

Table 5
Effect of the country of the Eastern European consumers on their attitudes towards castration¹.

| | Country ² | | | | | | | | | | | | | |
|--|----------------------|------------------|-------------------|--------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|--------------------|-------------------|------|
| | BIH | BGR | CZE | HRV | MKD | HUN | MDA | POL | ROU | SRB | SVK | SVN | UKR | RMSE |
| I think that surgical castration of pigs is... <i>1: Harmful; 4: Neither ... nor ...; 7: Beneficial</i> | 4.4 ^e | 2.6 ^g | 4.7 ^{cd} | 5.0 ^{bcd} | 5.1 ^{bc} | 6.2 ^a | 4.6 ^{de} | 3.5 ^f | 4.5 ^e | 4.7 ^{de} | 4.6 ^{de} | 4.4 ^e | 5.3 ^b | 1.8 |
| In my opinion, surgical castration of pigs is... <i>1: Easy; 4: Neither ... nor ...; 7: Difficult</i> | 5.2 ^a | 2.9 ^e | 2.7 ^e | 4.1 ^{bcd} | 3.8 ^d | 1.9 ^f | 4.4 ^{bc} | 4.4 ^b | 3.9 ^d | 5.4 ^a | 3.8 ^d | 4.0 ^{cd} | 4.0 ^{cd} | 1.8 |
| The surgical castration of pigs is... <i>1: Bad; 4: Neither ... nor ...; 7: Good</i> | 3.1 ^d | 5.5 ^a | 4.4 ^b | 4.6 ^b | 4.5 ^b | 5.7 ^a | 4.5 ^b | 3.6 ^c | 4.8 ^b | 3.8 ^e | 4.7 ^b | 4.6 ^b | 5.7 ^a | 1.8 |
| I believe that castrating pigs is something... <i>1: Natural; 4: Neither... nor ...; 7: Artificial</i> | 4.9 ^b | 5.0 ^b | 4.5 ^{cd} | 4.1 ^{def} | 3.6 ^{fg} | 3.6 ^{fg} | 3.3 ^g | 4.4 ^{de} | 3.8 ^f | 4.5 ^{cd} | 3.9 ^{ef} | 4.4 ^{de} | 5.6 ^a | 2.0 |
| Pig castration with vaccines is: <i>1: Bad; 4: Neither ... nor ...; 7: Good</i> | 4.1 ^{abc} | 2.8 ^e | 3.4 ^d | 3.8 ^{bcd} | 4.5 ^a | 2.4 ^e | 4.5 ^a | 3.9 ^{bc} | 4.2 ^{ab} | 4.3 ^a | 3.6 ^{cd} | 4.1 ^{abc} | 3.9 ^{bc} | 1.9 |

¹ Items in the same row and within classification category with different superscripts are significantly different (P < .05); RMSE: root-mean-square error.

² BIH: Bosnia and Herzegovina; BGR: Bulgaria; CZE: Czech Republic; HRV: Croatia; MKD: North Macedonia; HUN: Hungary; MDA: Moldova; POL: Poland; ROU: Romania; SRB: Serbia; SVK: Slovakia; SVN: Slovenia; UKR: Ukraine.

results or would help to understand them.

When consumers were asked if they believe that surgical castration is savage the average score (4.0) was again 'neither agree nor disagree', and it can be hypothesized that this answer is due to the lack of knowledge about castration even though it has not been tested. Although scores were significantly higher in women, consumers over 55 years old and urban consumers, the difference was rather low (maximum 0.2). Even low, differences between rural and urban consumers were significant for all three beliefs, in the sense that rural consumers think castration produce less pain, is more necessary and is less savage than urban consumers do. This is probably because rural consumers are more aware of pig production practices than urban consumers are. Regarding country of origin, some differences can be observed. Serbian (4.7) and Bosnian (4.7) consumers agreed with the statement. The similarity between answers should not be a surprise because the Muslim population, (non-pork eaters) of Bosnia and Herzegovina, was left out from the survey. Bulgarian (3.3) and Romanian (3.3) consumers disagreed and Hungarian (2.4) consumers strongly disagreed, while the rest of Eastern European consumers neither agreed nor disagreed that surgical castration is savage (Table 3).

3.3. Attitude towards surgical castration and immunocastration

The effect of gender, age, education, place of growing up and country of origin on the attitudes of Eastern European consumers towards castration is presented in Tables 4 and 5.

Average Eastern European consumers' opinion about whether surgical castration is harmful or beneficial tends to move to the beneficial side (4.6). The attitude about surgical castration being beneficial was significantly more pronounced for the consumers that grew up in rural (4.7) than in urban (4.5) areas. The same could be observed for the respondents older than 55 years compared to those younger than 36 years and in men (4.6) compared to women (4.5) (Table 4). Large differences between countries were observed, with Hungarian respondents (6.2) most strongly thinking that surgical castration is beneficial and Bulgarian ones (2.6) with a very strong opinion that it is harmful. On a beneficial end of the scale, consumers from Ukraine (5.3), North Macedonia (5.1) and Croatia (5.0) could be placed, and on the harmful end of the scale consumers from Poland (3.5) (Table 5). Castration of pigs was traditionally performed to avoid boar taint since pigs used to be much fatter and sexually mature at slaughter. The increased sensibility of consumers for animal welfare and the fact that standard/conventional pig production for fresh meat uses fast growing and highly muscled genotypes puts the necessity for castration under question. Besides, the consumers are nowadays less familiar with the ways the pork is produced, while on the other hand they are becoming more sensible about animal welfare. Furthermore, regarding management, castration of pigs has the advantage that reduces aggressiveness and mounting, thus, facilitates the handling. This result is interesting as it points certain conflicts in consumer's attitudes when harmful castration is opposed to benefits and emotions associated with the pleasure of eating pork meat. Some of the reasons that are behind the results are related with the degree of knowledge, the tradition of routinely castrate male piglets, what they have seen during their life, if they are familiar with pig production practices, the worry about animal welfare, the experience with pigs handling, etc.

An overall neutral opinion (4.0) was obtained about the easiness of the surgical castration of pigs. The effect of demographics was almost null with average scores 0.2 points lower for men and rural consumers. The background rural or urban was chosen by the consumers and it can be affected by their perception of the growing place, which may differ between consumers. The consumers from Hungary (1.9), followed by respondents from Czech Republic (2.7) and Bulgaria (2.9) think that surgical castration is easy to perform and the consumers from Serbia (5.4) and non-muslims from Bosnia and Herzegovina (5.2) think that this procedure is moderately difficult to perform, probably because of

the existing practice of castration in some rural places that have not changed much compared to castration practices done a century ago (Table 5). The opinion of the consumers about the difficulty to perform surgical castration might be related to the knowledge they have about it or by the information, they have received about it during their life. It would be logical to think that rural consumers know more about pig production practices than urban ones. Nevertheless, Serbian and Bosnian consumers are mainly (> 80%) rural (Table 1) and they considered surgical castration difficult to perform while Slovenian consumers were also rural (82%) and considered castration neither easy nor difficult. Nevertheless, although a high percentage of Slovenia consumers declared to grow in a rural place, probably most of them cannot be considered rural since only around 10% of the population could be considered real rural and this 'neither easy nor difficult' may indicate weak familiarity about this practice. Furthermore, Hungarian, who considered castration easy to perform were mainly rural but with less extent (60%). Thus, it is not clear whether the perception of easy or difficult to perform castration is related to the type of place where consumers consider to grow up (rural or urban). Another point is the fact that each consumer considered him/herself as rural or urban, and this classification can vary between consumers, especially those that grow up in median cities or villages. In some countries because of the size of the cities, urban people could not be real urban or rural could not be real rural.

Overall, the respondents were ambiguous (4.5) regarding the attitude about surgical castration being good. It was significantly more positive for the consumers that grew up in rural (4.7) than in urban (4.4) areas. The same pattern was observed for men (4.7) compared to women (4.5) (Table 3). Some consumers might have considered the answer to the statement 'good-bad' thinking on the pig from the animal welfare perspective. Other consumers that know the impact of the presence of boar taint in the meat from entire males might have associate the answer to this statement thinking on terms of the pork meat quality or environmental factors. In any case, this ambiguity reveals the true situation regarding the individual attitude towards surgical castration, for whatever reason.

Probably rural consumers are more familiar with pig castration and consider it a good practice, easy to perform and beneficial because it is a tradition or it is well endured by the animals, as considered by Flemish farmers (Tuytens, Vanhonacker, Verhille, De Brabander, & Verbeke, 2012). Hungarian, Ukrainian and Bulgarian consumers shared the same level of positive attitude (≥ 5.5) towards the statement that surgical castration is good while Bosnian, Polish and Serbian consumers shared a negative attitude (≤ 3.8). (Table 5). It could be of interest to know also differences in attitudes towards animal welfare since they could affect their attitude towards surgical castration.

The younger the population of the respondents was, they perceived the surgical castration as something more artificial. This was even more pronounced in respondents that grew up in urban areas (Table 4). On average, Eastern European consumers did not have a clear opinion (4.5) on whether castrating pigs is something natural or artificial. Only the Ukrainians (5.6) were more oriented towards the artificial end of the scale and Moldovians (3.3), Macedonians (3.6) and Hungarians (3.6) towards the natural part of the scale (Table 5). Curiously, Hungarian consumers were those that considered castration beneficial, easy, good and natural. Thus, in general, these consumers are in favour of castration. As far as the authors know, castration seems not to be a problem in Eastern European countries and this might influence their attitude towards this practice. Also, their attitude can be due to the unfamiliarity with this subject. Furthermore, in these countries there are not strong regulations regarding castration of boars.

This investigation revealed that in overall, Eastern European consumers are neutral (3.8) towards castration using the vaccine. Men (3.7) accepted less pig castration with vaccine than women (3.9), contrary to the findings reported for Belgian (Vanhonacker & Verbeke, 2011) and Swiss (Huber-Eicher & Spring, 2008) consumers, where

acceptance of castration with vaccines was also associated with gender but in the opposite way. Youngest (< 36) and urban consumers (3.9) also accepted more pig castration with the vaccine than the rest of the respondents (Table 4). The Hungarian (2.4) and Bulgarian (2.8) consumers demonstrated negative attitude towards castration with vaccines and the Macedonian (4.5) and Moldovan (4.5) a positive one (Table 5). Immunocastration is a usual management practice in countries like Australia, New Zealand and Brasil and consumers in those countries seem to accept this alternative to castration. Furthermore, consumer positive attitude towards immunocastration was also found in some of the European countries, such as Sweden, Belgium, France, Dutch, Germany and Denmark (Huber-Eicher & Spring, 2008), (Carlsson, Lagerkvist, & Viske, 2006) (Vanhonacker & Verbeke, 2011). On the other hand, a negative attitude towards immunocastration was found in Switzerland, which accepts immunocastration. It should be pointed out, however, that in most of these studies, information about vaccination was provided to the consumer, which was not the case in the present study. Thus, consumers' answer could be due to the lack of knowledge and information about the practice, due to a real knowledge of the practice or due to their opinion about vaccines in general (if they are good or bad, if they can affect at the quality, etc.).

3.4. Beliefs and preferences about the meat from castrated and vaccinated pigs

The effect of gender, age, education, growing place and country of origin on the beliefs and preferences of Eastern European consumers about meat from castrated and vaccinated pigs is presented in Tables 2 and 3.

The preference to eat meat from castrated pigs was on average was 4.5 and was significantly higher for consumers older than 35 years old than other investigated age groups. However, this difference was not relevant. There was not an Eastern European country, included in our investigation, where consumers disagreed about this preference. Thus, this neutral or positive consumers' preference for meat from castrated pigs in all the countries shows that piglet castration is presently not problematic on average. In half of the countries the consumers were undetermined about it. The rest either agreed more, like Bulgaria (5.7) and Hungary (5.6) or less like Romania (5.1), Ukraine (4.9) and Moldova (4.7). Regarding the belief that meat from castrated pigs is of better quality, the average score was tending to "I agree" (4.7). Thus it seems that in general this statement is accepted by consumers from all investigated countries. Scores were significantly higher for consumers older than 36 years and those who finished university studies. Scores were also higher for rural consumers. (Panella-Riera et al., 2010) found that rural consumers were more sensitive to androstenone than urban ones and this might influence their perception of meat quality from castrated pigs. None of the Eastern European countries studied disagreed about the better quality of castrated meat. Hungarians agreed the most (5.6) with the statement, followed by Romanians (5.2), Ukrainians and Moldovans (5.0). An average Eastern European consumer (4.7) would also more likely agree than disagree with this statement.

With respect to the statement 'Meat from castrated pigs is leaner', the overall average score was 3.8, thus, close to 'neither agree nor disagree'. The scores were significantly lower for men, consumers between 36 and 55 years of age and rural consumers, however, differences were not relevant. When a country is considered, only consumers from Bulgaria agree with this statement (5.3). Such belief of the Bulgarian consumers may be the result of their disagreement that meat from castrated pigs is of better quality (3.6) and that they preferred meat from castrated pigs (5.7) (Table 3). It has been demonstrated in numerous investigations that castrated pigs and their meat is fatter than those from entire male and female pigs (Gispert et al., 2010; Pauly, Spring, O'Doherty, Ampuero Kragten, & Bee, 2009; Zoltán, 2005). This is probably known by pig producers and butchers, but results of the present work suggest that it is not known by general consumers. Only

Slovenian consumers had an average score 'disagree' (3.4), which may indicate that they are more knowledgeable about biological mechanisms. This was significantly different only from those from Macedonian (4.0) and Bulgarian (5.3) consumers.

On average, Eastern European consumers were uncertain (3.9) if the meat from castrated pigs is more expensive. Again, differences in demographic characteristics were not relevant, but some significant differences were found in the gender, age group and education level of the consumers. When countries were analysed, it was observed that, consumers from Bulgaria and Hungary disagreed (3.3) and those from Bosnia and Herzegovina agreed (4.5) with such a statement. In fact, most of the times people buy meat, the sex of the animal is not provided and customers do not ask for it, thus, it is difficult to know if meat from castrated pigs is more expensive or not. In some countries like Slovenia, meat from entire males is less valued at the end of the slaughterplant, but it does not affect the consumer and this is not information that ordinary people know.

The advantages of immunocastration in terms of performances (i.e. higher daily weight gain, better feed conversion and higher percentage of lean meat) and boar taint prevention (lower or null levels of androstenone and skatole) have been demonstrated (see meta-analysis of Batorek et al., 2012) and are well known to scientists and professionals. However, this is not the case with the consumers; their beliefs towards the claim that immunocastration improves pork quality was on average 3.7 (slightly below neutral), with 0.1 average points higher in women than men. Hungarian (2.6) and Bulgarian (3.0) consumers strongly disagreed with this statement (Table 3). This result corroborates with the low perception of pig castration with vaccines (Table 5).

Willingness to pay more for meat from castrated pigs was on average (4.1) uncertain. No significant effect of gender, education level or place where they grew up was found. Only some differences between age groups were observed, being slightly higher (more agreement) for those consumers older than 55 years (Table 2). Even the scores of the consumers of most of the countries were 'neither agree nor disagree', Bulgarian consumers (2.9) disagreed while Hungarian (4.5) and Romanian (4.6) consumers tended to agree with such proposition (Table 3). In both countries, and especially in Hungary, consumers prefer the meat from castrated pigs and consider it to be of better quality than meat from uncastrated pigs. This could have influenced their higher willingness to pay for such meat. A recent cross cultural study, covering four Western European countries, also investigated consumers' willingness to pay for meat from physically castrated pigs using a 7-point scale (Vanhonacker & Verbeke, 2011). They provided information to the consumers about the benefits of producing castrated and immunocastrated pigs. In spite of that, their results revealed that only German consumers gave an absolute score above four (4.3), while Belgian (3.25), French (3.80), and Dutch (3.76) consumers expressed a negative willingness-to-pay behavioural intention. From the results of this study it can also be observed that, although generally ambivalent about this matter, an average Eastern European consumer was more willing to pay for meat from physically castrated pigs (4.1) than an average Western European consumer (3.85) from a pooled sample of four countries (Vanhonacker & Verbeke, 2011). Again, the information provided to the consumers may affect their answer (Tuytens et al., 2011).

3.5. Segments of consumers according to their beliefs and attitudes towards castration

When consumer studies are performed it is relevant to detect segments of consumers to have a better picture of their beliefs and attitudes. If several countries are included in the study, segments of consumer could be determined, considering all the participants, to perform a cross-country segmentation analysis (Vanhonacker & Verbeke, 2011), which would allow to know the Eastern European market structure. Following the clustering procedure, three clusters were defined with the

Table 6
Description of the three clusters in terms of demographics.

| % | Cluster 1 (n = 2568) | Cluster 2 (n = 1693) | Cluster 3 (n = 1199) | Total (n) |
|----------------------------|-------------------------|-------------------------|-------------------------|-----------|
| <i>Country</i> | | | | |
| Bosnia and Herzegovina | 93.0 | 6.7 | 0.3 | 312 |
| Bulgaria | 11.9 | 75.3 | 12.8 | 352 |
| Czech Republic | 43.5 | 31.0 | 25.5 | 510 |
| Croatia | 53.8 | 21.6 | 24.6 | 301 |
| North Macedonia | 45.4 | 17.3 | 37.3 | 284 |
| Hungary | 12.0 | 34.3 | 53.8 | 400 |
| Moldova | 44.1 | 24.7 | 31.1 | 299 |
| Poland | 72.8 | 16.5 | 10.7 | 504 |
| Romania | 25.3 | 38.2 | 36.4 | 557 |
| Serbia | 76.5 | 15.1 | 8.4 | 664 |
| Slovakia | 53.3 | 17.7 | 29.0 | 300 |
| Slovenia | 57.5 | 23.7 | 18.9 | 228 |
| Ukraine | 31.5 | 56.2 | 12.3 | 749 |
| <i>Gender</i> | | | | |
| Male | 44.7 | 32.7 | 22.6 | 2435 |
| Female | 48.9 | 29.7 | 21.4 | 3025 |
| <i>Place of growing up</i> | | | | |
| Urban | 44.1 | 36.3 | 19.6 | 2447 |
| Rural | 50.6 | 24.5 | 24.9 | 3013 |
| <i>Age</i> | | | | |
| < 36 | 48.2 | 32.7 | 19.1 | 1869 |
| 36–55 | 47.4 | 31.3 | 21.3 | 2078 |
| Above 55 | 44.9 | 27.4 | 26.7 | 1513 |

ratio of sizes between the largest and smallest clusters being larger than two. Their characteristics and answers to the different statements are detailed in [Tables 6 and 7](#), respectively.

The largest Cluster 1, contained almost a half of all the Eastern European consumers (47%), taking in nearly all of the respondents from Bosnia and Herzegovina (93%), three quarters of Serbian (76.5%) and Polish (72.8%) and more than a half of the Croatian (53.8%), Slovakian (53.3%) and Slovenian (57.5%) consumers. This cluster could be named as ‘Consumers against castration’, since his was the only cluster that significantly leaned towards the “I agree” end of the scale for the claim “Castration is not necessary” (4.5) and “Surgical castration is savage” (4.7). It was also unique in terms that these consumers were ambivalent about whether they prefer to eat meat from castrated pigs (3.9) while the rest of the Eastern European consumers in Clusters 2 and 3 agreed with the statement (5.0 and 5.3, respectively). The attitudes towards castration for this group of consumers (Cluster 1) were also exceptional in terms that they considered surgical castration as something bad (3.3) and difficult to perform (5.0) while being indecisive if it was harmful or beneficial (3.9). The rest of the Eastern European consumers in Clusters 2 and 3 considered surgical castration as beneficial (4.9 and 5.9, respectively). Similarly, [Vanhonacker and Verbeke \(2011\)](#) in a study involving consumers from Belgium, France, Germany and The Netherlands identified one segment of consumers (59.1%) named ‘average, ethics-oriented’ with low acceptance for physical castration. In this case information was provided to the consumers who were asked to consider only surgical castration with anaesthesia to improve animal welfare reducing pain and stress and they explained them the advantages and inconvenients of castrating pigs. Moreover, information about immunocastration was also provided but this segment of consumers also would also avoid it. Willingness to pay for physical castration was lower for Belgian than German consumers, being in between for German and Dutch consumers, and a segment of consumers price oriented (19.2%) was identified ([Vanhonacker & Verbeke, 2011](#)).

Cluster 2 enclosed almost a third of the overall sample (31%), containing three quarters of all Bulgarian (75.3%), more than a half of Ukrainian (56.2%) and more than a third of Romanian (38.2%) and Hungarian (34.3%) consumers ([Table 6](#)). This Cluster could be named

Table 7
Description of the three clusters regarding believes and attitudes towards castration and meat from castrated pigs¹.

| | Cluster 1 (n = 2568) | Cluster 2 (n = 1693) | Cluster 3 (n = 1199) | RMSE |
|---|----------------------|----------------------|----------------------|------|
| The believes about castration and meat from castrated pigs | | | | |
| 1: Disagree very strongly; 4: Neither ... nor ...; 7: Agree very strongly | 5.1 ^a | 5.0 ^a | 4.4 ^b | 1.5 |
| The surgical castration produces pain to the animal | 5.4 ^a | 4.8 ^b | 4.3 ^c | 1.4 |
| The meat from castrated pigs is of better quality | 4.1 ^a | 3.8 ^b | 3.6 ^c | 1.3 |
| The meat from castrated pigs is more expensive | 4.5 ^a | 3.1 ^b | 2.7 ^c | 1.4 |
| The castration is not necessary | 3.8 ^b | 3.9 ^a | 3.8 ^{ab} | 1.3 |
| Meat from castrated pigs is leaner | 4.7 ^a | 3.7 ^b | 3.0 ^c | 1.4 |
| The surgical castration is savage | 3.9 ^c | 5.0 ^b | 5.3 ^a | 1.8 |
| I prefer to eat meat from castrated pigs | 3.9 ^a | 3.6 ^b | 3.5 ^b | 1.4 |
| Pig castration with vaccines improves pork quality | 3.8 ^c | 4.2 ^b | 4.4 ^a | 1.5 |
| I am willing to pay a little more for meat from castrated pigs | | | | |
| The attitudes towards castration: | | | | |
| I think that surgical castration of pigs is... | 3.9 ^c | 4.9 ^b | 5.9 ^a | 1.8 |
| 1: Harmful; 4: Neither ... nor ...; 7: Beneficial | | | | |
| In my opinion, surgical castration of pigs is... | 5.0 ^a | 3.4 ^b | 2.7 ^c | 1.8 |
| 1: Easy; 4: Neither ... nor ...; 7: Difficult | | | | |
| The surgical castration of pigs is... | 3.3 ^c | 5.4 ^b | 6.0 ^a | 1.6 |
| 1: Bad; 4: Neither ... nor ...; 7: Good | | | | |
| I believe that castrating pigs is something... | 4.8 ^b | 5.7 ^b | 1.9 ^c | 1.6 |
| 1: Natural; 4: Neither ... nor ...; 7: Artificial | | | | |
| Pig castration with vaccines is | 3.9 ^a | 3.8 ^b | 3.7 ^b | 1.9 |
| 1: Bad; 4: Neither ... nor ...; 7: Good | | | | |

¹ Items in the same row and within classification category with different superscripts are significantly different (P < .05); RMSE: root-mean-square error.

as ‘Consumers indifferent towards castration’ since their answers on 12 out of 14 statements were in between the answers from the respondents of Cluster 1 and Cluster 3. Moreover, their answers on half of the questions were mainly characterized by a high number of respondents positioning themselves in the middle of the scale. Such answering behaviour reflects consumers that express uncertainty and/or unawareness (Vanhonacker et al., 2009) while categorical indifference is a common attitude of respondents towards topics which are not completely comprehended (Huber-Eicher & Spring, 2008). The consumers’ unawareness of piglet castration and the vaccine method is not genuine to the Eastern European market since it was also found in Norwegian (Fredriksen et al., 2011). Furthermore, only about one fifth (18.4%) of Western European consumers (including Belgian, French, German and Dutch consumers) know a lot about physical castration and a large majority (86.8%) of them never heard about the vaccine method (Vanhonacker & Verbeke, 2011). The only distinguishing characteristic of Cluster 2 consumers in the present survey, was their strong attitude that castrating pig was something artificial (5.7). In fact, naturalness was the option of few consumers that consider castration or immunocastration unacceptable in Norway (Fredriksen et al., 2011). Cluster 1 also provided the lowest scores on willingness to pay for meat from castrated pigs, which could be related with the fact that they are against castration.

Cluster 3 was the smallest comprising roughly one fifth (22%) of the sample surveyed in our investigation. It covered 53.8% of the Hungarian, 37.3% of Macedonian, 36.4% of Romanian and 31.1% of Moldovan consumers (Table 6). Gender, place of growing up and the age of the respondents were not a distinctive characteristic of Cluster 3, as they were not with the Cluster 1 and Cluster 2, before. What distinct about Cluster 3 from the other two clusters is the disbelief that castration is not necessary (2.7), the disagreement that it is savage (3.0) and the preference for eating meat from castrated pigs (5.3). These consumers were also unique in terms of their attitudes towards castration because they were positive that it is beneficial (5.9), good (6.0), natural (1.9) and easy to perform (2.7). They also presented the highest willingness to pay scores for castrated meat (4.4). Thus, this cluster could be named as ‘Consumers pro-castration’. Similar to other clusters, they were ambivalent if the pig castration with vaccines is good or bad, and if the meat from castrated pigs is leaner. Similarly, Vanhonacker and Verbeke (2011) identified a cluster of consumer (21.7%) named ‘low-ethics, health-oriented’ with the highest acceptance for physical castration.

The segmentation shows that the average results (suggesting that castration is not problematic) are strongly misleading. The somewhat “neutral” average opinion actually results from the addition of negative and positive opinions towards castration.

4. Conclusions

In the condition of this exploratory study, the results show that different beliefs and attitudes towards castration and meat from castrated pigs can be observed in consumers from Eastern European countries. In general, the beliefs and attitudes of the consumers are not defined, probably because of the lack of knowledge towards these important issues. However, when consumers are classified in clusters, clear differences between them can be identified, especially in the beliefs about the necessity of castration, the belief that castration is savage and the preferences for eating meat from castrated pigs. Also, most of the attitudes regarding surgical castration varied between these segments of consumers. In this sense, most of the consumers considered castration artificial, bad and difficult, some other consumers considered castration natural, good, easy and beneficial and, another group of consumers have opinions in between them. It is important to know the opinion of consumers to be able to direct the information to be provided and how to do it.

In this context it would be interesting to know if Eastern European

consumers, and by extent also producers, are prepared to the ban of surgical castration and if a transition period to introduce immunocastrated and boar meat would be necessary.

It should be emphasized that this is the first study on pig castration attitudes and beliefs conducted in most of the Eastern European countries included in the investigation and more work is needed to get a further insight into the effect of the information provided on the consumers’ answers. In addition, it would be beneficial to investigate consumers’ beliefs and attitudes towards animal welfare, as they could influence their attitudes and beliefs towards castration.

Declaration of Competing Interest

None of the authors has a financial or personal relationship with other individuals, organizations or governmental bodies that could unsuitably influence or bias the contents of this paper.

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Appendix A. Supplementary data

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