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Attitudes of Serbian food technology students towards surgical and immunocastration of boars and their sensitivity to androstenone and skatole

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Abstract. Various European Union pork chain actors and stakeholders agreed in 2010 on a road map to voluntarily abandon piglet castration by 1 January 2018. Because currently in Serbia, male piglets are surgically castrated and consumers are not used to the boar taint odour and flavour, the introduction of boar meat may modify the acceptability of pork. The objective of the study was to investigate the attitudes, awareness and opinions of future Serbian food technologists towards surgical castration of boars and its alternatives, and to test their sensitivity to androstenone and skatole. We found that they were concerned about the animal welfare issues and that they were willing to pay a little more for meat from animals treated with dignity. This was more so if they were females and less so if they had had a rural upbringing. They strongly believed that surgical castration is painful for the animals, but at the same time agreed that meat from castrated pigs is of better quality. Their ambiguous attitudes regarding efficacy and quality of alternatives to surgical castration clearly indicated the knowledge gap that must be filled by appropriate modifications of the curriculum. Students demonstrated average sensitivity to both androstenone and skatole. Females exhibited higher intensities of difference in both cases.

1. Introduction

Boar taint is an offensive odour and flavour present in meat from some non-castrated male pigs. This defect has principally been ascribed to androstenone (sex steroid produced by testes) and skatole (product of bacterial degradation of tryptophan in the gut). Surgical castration of male piglets is a standard practice in pork production to prevent this boar taint in meat. Due to the different odours of androstenone (urine or sweat like) and skatole (faecal), it is likely that both substances contribute separately in an additive



manner to off-odour, but they differ in their origin, chemical properties and the likelihood of consumer reactions. Their relative contribution is determined by both the sensitivity of consumers and the frequency of carcasses with high concentrations of the respective substances [1]. In contrast to androstenone, skatole is perceived by 99% of consumers, but the percentage of boar carcasses high in skatole concentrations is much lower than the percentage of carcasses with high androstenone concentrations [2]. Previous study also showed that only those consumers who perceive the odour of pure androstenone as unpleasant clearly differentiated tainted from non-tainted entire male pork [3].

In Europe, the proportion of male pigs that are left entire (uncastrated) has been high for many years in the British Isles and Iberian Peninsula, and has recently increased in The Netherlands and to a lesser extent in Germany, Belgium and France. Various European Union pork chain actors and stakeholders agreed in 2010 on a road map to voluntarily abandon piglet castration by 1 January 2018 [4]. With regard to meat quality, the main challenges in pork production with entire males concern firstly, the reduction of boar taint and secondly, altered meat technological properties [5-7]. As no rapid online detection method for boar taint is yet available, complete non-castration poses risks because consumers could reduce their consumption of pig meat due to the presence of boar-tainted meat [8].

In Serbia, surgical castration is most frequently performed without anaesthesia. The procedure, as traditionally performed, negatively affects performances and is painful [9], the latter reason being why surgical castration is performed with pain treatment or has been abandoned in several countries where animal welfare has been a growing concern [10]. When abandoning castration, it is necessary to find alternative solutions to prevent this taint defect in meat. One of the promising alternatives to surgical castration effectively preventing boar taint is immunocastration [11]. Today, immunocastration is an alternative to the production of entire male pigs. The main problem for the wider use of immunocastration seems to be the fear related to consumer acceptance [5].

Because today in Serbia, male piglets are surgically castrated and as the consumers are not used to the boar taint odour and flavour, the introduction of boar meat could modify consumer acceptability of pork. The data collected by the Serbian Chamber of Commerce shows that, in 2015 alone, Serbia imported 20,100 tons of pork (€40.8 million) mostly from Spain, Hungary and Germany. The same year, Serbia exported 12,000 tons of pork valued at €24.3 million [12]. The lack of knowledge of future Serbian food technologist about the production of entire males (EM) or immunocastrates (IC) would lead to their inability to cope with the challenges in management of product quality (detecting and reducing boar taint, coping with extreme leanness), further compromising the competitiveness of the Serbian pork sector in the future.

The objective of the present study was, therefore, to investigate the attitudes, awareness and opinions of future Serbian food technologist towards surgical castration of boars and its alternatives, and to test their sensitivity to androstenone and skatole. We believe that insights in their attitudes towards this important and contemporary animal welfare and meat technology issue and the identification of probable knowledge gaps will be useful to better coordinate and target their upcoming training on this topic.

2. Materials and methods

2.1. Survey

The survey of 100 randomly selected food technology students (undergraduate and postgraduate studies) at the University of Belgrade – Faculty of Agriculture – on the perception of castration of male pigs was conducted during 2017. A brief 15 minute introduction about surgical and immunocastration of piglets was presented to the students prior to the survey.

A structured questionnaire was developed and consisted of three sections. The first section included general demographic information about the respondents. The second section explored 13 statements

related to the castration of male pigs from the welfare (6 items) and economic (2 items) points of view and meat preferences and beliefs (5 items) giving the respondents the opportunity to rate their degree of agreement on a seven-point Likert scale: 1 “Disagree very strongly”, 2 “Disagree strongly”, 3 “Disagree”, 4 “Neither agree nor disagree”, 5 “Agree” 6 “Agree strongly” to 7 “Agree very strongly” (Table 1). The third section gave the respondents the opportunity to state their attitudes towards surgical castration and immunocastration using a 7-point scale (1 – "Harmful / Easy / Bad" 4 – “Neither harmful nor beneficial / Neither easy nor difficult / Neither bad nor good”, 7 – “Beneficial / Difficult / Good”).

2.2. Triangle test

Triangle tests were performed to evaluate whether assessors (students) could differentiate paper strips with spiked solution of androstenone (A) and skatole (S) from blank paper strips. Sixteen assessors (8 male and 8 female postgraduate students) participated in the triangle test, and replicated their evaluations twice. This made a total of 32 evaluations for each compound. Half of the assessors (4 male and 4 females) participated in first test where the odd sample (paper strip with compound “B”; blank paper strip “A”) had the following combination for the two replications: (AAB, ABA, BAA). The second test was presented to the other half of the assessors with the following combination of strips for the two replications (AAB, ABA, BAA, BBA, BAB, ABB) [13, 14].

Instructions to the participants included (i) a presentation of the task; (ii) the obligation to evaluate the samples in the imposed order; (iii) the obligation to give a response; (iv) the possibility of giving their opinion on the degree of difference between the sample they chose and the others by circling one of the following descriptors which most closely described the intensity of difference (0 = none; 1 – very slight; 2 – slight; 3 – moderate; 4 – large; 5 – extreme).

2.3. Statistical processing

The 13 statements considered in the survey were subjected to a principal component analysis (PCA) to gain a better understanding of the overall correlations in the data set. A Varimax orthogonal rotation was employed to aid interpretability. The Mann-Whitney U test was carried out to determine if statistically significant differences exist between genders or place where students were born and raised (rural or urban).

For the triangle test, the null hypothesis is $H_0: n_c = 1/3 n$, with n_c = observed number of correct responses and n = total number of responses. The alternative hypothesis is $H_1: n_c > 1/3 n$. The critical number of correct responses to reject H_0 at $\alpha = 0.05$ in favour of H_1 was obtained from the binomial distribution [13, 14].

All data were analysed using SPSS Statistics 17.0 (Chicago, Illinois, USA) data analysis software.

3. Results and discussion

3.1. Attitudes of students towards surgical and immunocastration of boars

Out of 100 students who participated in the study, three questionnaires were excluded because of failure to answer 50% or more of the questions, and 97 questionnaires were further processed. Demographic profiling showed that female students prevailed (63.9%). Approximately half of respondents grew up in rural surroundings (52.6%) while 47.4% of them grew up in urban areas.

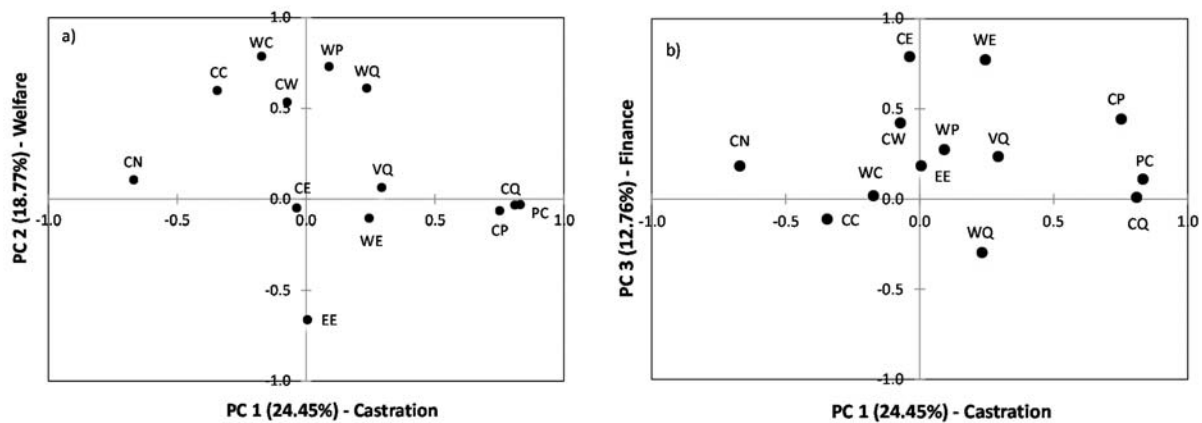


Figure 1. Principal component analysis loadings plot.
(Explanation of the abbreviations given in Table 1)

A PCA was run on the 13 statements about castration of male pigs. The suitability of PCA was assessed prior to analysis. The overall Kaiser-Meyer-Olkin (KMO) measure was 0.688. Bartlett's test of sphericity was statistically significant ($p < 0.0005$), indicating that the data was likely factorizable. PCA revealed three components that had eigenvalues greater than one. Visual inspection of the scree plot indicated that these components should be retained [15]. In addition, a three-component solution met the interpretability criterion. As such, three components were retained and this solution explained 56% of the total variance. The rotated solution exhibited 'simple structure' [16]. The interpretation of the data was consistent with the statements the questionnaire was designed to measure, with strong loadings of "Castration" items on Component 1, "Welfare" items on Component 2, and "Finance" items on Component 3 (Figure 1). Only the item 'pig castration with vaccines improves pork quality' is not well explained by any of the three principal components.

On average, Serbian food technology students strongly agreed that surgical castration produces pain to the animals (6.1) and believe that taking care of animal welfare produces meat of higher quality (5.9) (Table 1). They were willing to pay a little more for meat from animals treated with dignity (5.3) and they were worried about welfare of animals for human consumption (5.2). They consider that meat from castrated male pigs is of better quality (5.1) while believing that surgical castration of animals is cruel (5.1). Female students were more concerned about animal welfare issues and were significantly more convinced that taking care of animal welfare produces meat of higher quality.

On average, students had no preference about eating meat of castrated pigs (4.2), or willingness to pay a little more for meat from castrated pigs (4.1). They neither agreed nor disagreed whether meat from castrated pigs is more expensive (4.1), whether castration of animals for human consumption is necessary (3.9), or if pig castration with vaccines improves pork quality (3.7) and whether ensuring animal welfare means to eat meat that is more expensive (3.7). Finally, they strongly disagreed with the statement that it does not matter if we mistreat the animals because at the end we eat them. Students who were raised in rural environments were less convinced that surgical castration is cruel, while the statement that ensuring animal welfare means to eat meat that is more expensive was more agreeable to students raised in urban environments (data not shown).

Table 1. Statements about the castration of boars given by the male and female food technology students

Statements	Male	Female	Total
N	35	62	97
Surgical castration produces pain to the animal (CW)	6.0 ± 1.1	6.1 ± 1.2	6.1 ± 1.2
Taking care of animal welfare produces meat of higher quality (WQ)	5.5 ± 1.5 ^a	6.1 ± 1.1 ^b	5.9 ± 1.3
Meat from castrated pigs is of better quality (CQ)	5.3 ± 1.5	5.0 ± 1.3	5.1 ± 1.4
The meat from castrated pigs is more expensive (CE)	4.2 ± 1.4	4.1 ± 0.9	4.1 ± 1.1
I am willing to pay a little more for meat from castrated pigs (CP)	4.3 ± 1.6	4.0 ± 1.4	4.1 ± 1.5
I am worried about welfare of animals for human consumption (WC)	4.9 ± 1.4	5.4 ± 1.1	5.2 ± 1.2
The castration is not necessary (CN)	3.9 ± 1.6	4.0 ± 1.8	3.9 ± 1.7
I am willing to pay a little more for meat from animals treated with dignity (WP)	4.9 ± 1.4 ^a	5.6 ± 1.3 ^b	5.3 ± 1.4
The surgical castration is cruel (CC)	4.6 ± 1.9 ^a	5.4 ± 1.2 ^b	5.1 ± 1.6
Does not matter if we mistreat the animals because at the end we eat them (EE)	2.1 ± 1.0	1.9 ± 1.5	2.0 ± 1.3
I prefer to eat meat of castrated pigs (PC)	4.5 ± 1.4	4.1 ± 1.6	4.2 ± 1.5
To ensure animal welfare means to eat meat that is more expensive (WE)	3.7 ± 1.7	3.8 ± 1.6	3.7 ± 1.6
Pig castration with vaccines improves pork quality (VQ)	3.6 ± 1.7	3.8 ± 1.4	3.7 ± 1.5

Note: Items denoted with different letters within a row are significantly different at the level of 5%.

(1) “Disagree very strongly”, (2) “Disagree strongly”, (3) “Disagree”, (4) “Neither agree nor disagree”, (5) “Agree”, (6) “Agree strongly”, (7) “Agree very strongly”.

Students also believed that surgical castration is neither harmful nor beneficial (4.3 ± 2.2 ; 1 “Harmful”, 4 “Neither harmful nor beneficial”, 7 “Beneficial”), that surgical castration is neither easy nor difficult (3.7 ± 2.2 ; 1 “Easy”, 4 “Neither easy nor difficult”, 7 “Difficult”) and that pig castration with vaccines is neither good nor bad (4.3 ± 2.1 ; 1 “Bad”, 4 “Neither good nor bad”, 7 “Good”).

3.2. Triangle test

The sensory analysis showed that the paper strips loaded with androstenone can be distinguished as different ($n=32$, $n_c=23$) at the level of $\alpha=0.05$. With 95% confidence level, at least 38% of the consumers could distinguish the two samples. It seems that the percentage of consumers sensitive to androstenone assessed in our study was a little lower compared to the general average of 45% [17]. The average degree of difference for correct answers was 1.9 ± 1.6 with no significant difference between correct and incorrect answers ($p \geq 0.05$). Female assessors ranked the degree of difference higher compared to male assessors (2.00 opposed to 1.75). Our result is in agreement with a previous general conclusion that sensitivity of consumers to androstenone is higher in women than in men [17].

The sensory analysis showed that the paper strips loaded with skatole can be distinguished as different ($n=32$, $n_c=24$) at the level of $\alpha=0.05$. With 95% confidence level, at least 44% of the consumers could distinguish the two samples. The average degree of difference for correct answers was 4.0 ± 1.0 with no significant difference between correct and incorrect answers ($p \geq 0.05$). Female students who noticed the differences responded that the degree of difference was higher (4.50) compared to male students (3.42).

4. Conclusions

It is obvious that future Serbian food technologists are concerned about the animal welfare issues and that they are willing to pay a little more for meat from animals treated with dignity. This was more so if they were females and less so, if they had had a rural upbringing. They strongly believed that surgical castration is painful for the animals, but at the same time, agreed that meat from castrated pigs is of better quality. Their ambiguous attitudes regarding efficacy and quality of alternatives to surgical castration clearly indicate a knowledge gap that must be filled by appropriate modifications of the curriculum. Students demonstrated average sensitivity to both androstenone and skatole. Females exhibited higher intensities of difference in both cases.

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