

Belgian consumers' attitude towards surgical castration and immunocastration of piglets

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Abstract

In the vast majority of European countries, piglets are surgically castrated in order to eliminate the risk of boar taint, an odour or flavour that can be present when pork from entire males is cooked. However, surgical castration is the subject of much debate and criticism as a result of its negative implications for piglets' welfare, integrity and health. At present, there is much ongoing research into potential alternatives, among them immunocastration. This practice involves the injection of a vaccine that inhibits the production of the hormones responsible for boar taint. Although satisfactory results are associated with immunocastration in terms of meat quality and production parameters, uncertainty concerning consumer acceptance is often put forward as a key element in the quest for a successful market introduction. This study focuses on consumer awareness of piglet castration and attitudes towards immunocastration by means of a web-based questionnaire among 225 Flemish consumers. We noted approximately 40% awareness of the routine practice of castrating piglets and this limited awareness is accompanied by a moderate level of concern regarding castration, especially in comparison to food safety and other pork production system-related animal welfare issues. Sixty percent of the sample had a general appreciation for the concept of immunocastration, as opposed to surgical castration. Informing consumers about the potential benefits and/or risks from immunocastration did not tend to have much effect in terms of altering their attitudes. Immunocastration did not emerge as a problem in terms of consumer acceptance: special attention should be paid to consumers' perception of pricing, food safety and the taste of the meat from immunocastrated pigs.

Keywords: animal welfare, attitude, consumer acceptability, immunocastration, pigs, vaccination

Introduction

Castration of male piglets is widely practised to avoid boar taint, an unpleasant odour that can be released during the cooking of pork from entire boars. Boar taint is associated with the presence of androstenone (Patterson 1968) and skatole (Vold 1970; Walstra & Maarse 1970). Castration of male pigs is an effective method of eliminating the production of both substances and surgical castration without anaesthesia is the most commonly applied practice in Europe. However, within Europe, there is general agreement regarding the need to re-evaluate this practice, in line with the development of feasible and ethically superior alternatives (Federation of Veterinarians of Europe 2001). At present (March 2009), surgical castration without anaesthesia and/or analgesia is prohibited in Norway, Switzerland, The Netherlands (domestic market) and Germany. In many other European countries, banning of surgical castration is currently under consideration (Font i Furnols *et al* 2008). Furthermore, the EU-funded Specific Support Action (PIGCAS) was launched in 2007 in response to the need for further information about the

practice of, the attitude towards, and the research needs concerning piglet castration (von Borell *et al* 2008).

Surgical castration without anaesthesia has been criticised for the violation of the piglets' welfare, integrity and possibly health (EFSA 2004; Prunier *et al* 2006). This has triggered a cascade of research for more humane, alternative methods to eliminate or strongly reduce the occurrence of boar taint. These alternatives include surgical castration with anaesthesia and/or analgesia, growing entire males (combined with management and selection techniques to reduce boar taint prevalence and/or at-slaughter detection methods to remove tainted carcasses from the foodchain), sperm sexing, such that only female offspring is produced, and immunocastration. The focus of this consumer study is on immunocastration which is also referred to as the vaccination method for piglet castration. Immunocastration involves the blocking of testes development and function through neutralisation of the production of gonadotropin releasing hormone. This results in the non-production of androstenone and a heavily-reduced production of skatole, thereby preventing the problem of boar taint. Application of

the method consists of injecting the pig twice with a vaccine (eg IMPROVAC[®], Pfizer Animal Health Inc, New York, USA). Presently, immunocastration is practiced in a number of countries, including Australia, New Zealand, Brazil, Russia, Switzerland and several South American and Asian countries. The vaccine, IMPROVAC[®], has very recently (March 2009) received an initial marketing authorisation for application on the EU market. In conjunction with enhanced animal welfare, immunocastrated pigs have also been shown to have a more favourable feed conversion (Dunshea *et al* 2001; Turkstra *et al* 2002; Cronin *et al* 2003; Jaros *et al* 2005), and a higher percentage of lean meat (Jaros *et al* 2005) compared to surgically-castrated pigs and reduced sexual and aggressive behaviour compared to intact boars (Cronin *et al* 2003; Velarde *et al* 2008). Drawbacks include vaccination costs (vaccine and labour), the risk of self-injection and uncertainties regarding consumer/market acceptance of the method (Prunier & Bonneau 2006; Prunier *et al* 2006; Font i Furnols *et al* 2008). Nonetheless, estimations indicate that vaccination costs can be largely compensated for by the benefits of an increased feed efficiency (PIGCAS 2008). Also, specific injection devices have been developed that reduce the risks of self-injection, in addition to the development of anti-vaccines.

Although the consequences of immunocastration for production performance and animal behaviour have been investigated in several studies (for a review see Prunier *et al* 2006), little research has been conducted on consumer acceptance. In a study by Font i Furnols *et al* (2008), the focus was on the sensory evaluation and acceptability of meat from immunocastrated pigs in Spain, concluding that Spanish consumers were unable to distinguish between cooked pork from immunocastrated pigs, surgically-castrated pigs and female pigs. Despite this favourable result in terms of sensory evaluation, these findings neither provide an insight into consumers' buying intentions and behaviour nor reveal any insight in terms of consumers' beliefs and attitudes, which can be expected to be antecedents of behavioural intentions. To the authors' knowledge, the only studies that have dealt with consumer issues, with the exception of sensory studies, are a study in Australia (Hennessy & Newbold 2004), a study in Sweden (Lagerkvist *et al* 2006) and two studies in Switzerland (Giffin *et al* 2008; Huber-Eicher & Spring 2008). Considering the relatively high animal welfare standards and divergence in public interest in farm animal welfare and ethical issues across countries, generalisation of findings from these studies to other European countries remains quite speculative.

Hennessy and Newbold (2004) found, through qualitative focus group discussion with Australian females responsible for food purchases, that immunocastration was strongly accepted, despite a limited awareness of the practice. The vaccination method was associated with a natural process and perceived as a favourable alternative to surgical castration without anaesthesia. Lagerkvist *et al* (2006) also found immunocastration to be a socially-acceptable alternative,

based on willingness-to-pay estimates from a choice experiment with Swedish consumers. They found that animal welfare concerns dominated aversion to biotechnology or perceived food safety risks, while animal welfare concerns were secondary to sensory quality concerns. Regarding the two Swiss studies, conflicting results appeared. The study of Giffin *et al* (2008), which was based on 971 on-line interviews regarding pork consumers' acceptance of the vaccination method, revealed that two-out-of-three consumers considered immunocastration more acceptable than surgical castration. Huber-Eicher and Spring's (2008) study, in stark contrast, revealed a low acceptance of meat from immunocastrated animals among 800 Swiss consumers, with 56% indicating a lack of willingness to buy this meat. Surgical castration under anaesthesia/analgesia was preferred since it was most transparent to the consumer and reliably eliminated the risk of boar taint. Within the PIGCAS project, where the consumer voice is represented by consumer organisations, a similar preference for castration under anaesthesia was found (von Borrell *et al* 2008).

The objective of the present study was to investigate the awareness, concern, attitude and willingness-to-pay of Flemish (inhabitants of the northern region of Belgium) consumers concerning immunocastration in pig production and pork from immunocastrated pigs. Given that this research topic is largely unexplored and that no primary data, as such, is yet available in Flanders, this research is organised and designed as a preliminary qualitative study. It provides an insight into the degree to which it is justified to consider consumer acceptance as a key issue for the implementation of immunocastration. More specifically, issues on which this practice scores favourably or otherwise, as perceived by consumers, are reported. An additional aim of the study is to explore the impact of communication messages informing consumers about the benefits and/or risks from immunocastration.

Materials and methods

Research approach and sampling

Survey data were collected through self-administered, web-based questionnaires in Flanders during January and February 2008. Participants were recruited through non-probability snowball-sampling. This involves initial contact persons being asked to complete the questionnaire, together with the request to send the web-link to their acquaintances, and so on. This sampling method is efficient at gathering a substantial amount of data in a short period of time and with a limited budget; ideally for a preliminary qualitative type of data collection. It should be noted that this sampling method does not yield a statistically-representative sample. Hence, findings mainly apply within the characteristics of the sample and generalisation to the overall population is not appropriate. Nonetheless, the contact with respondents was steered in such a way as to obtain a wide diversity in terms of gender, age, family size and living environment (Table 1).

Questionnaire and scales

The questionnaire began with a number of general questions regarding animal welfare and pig production. First, respondents were provided with an extended and diverse list of items (27 in total) that are related to characteristics of and practices in the pig production chain that have an impact on the animals' welfare, among them piglet castration. These items were selected from an exhaustive list of characteristics of practices in livestock production that play a role in the citizens' interpretation of the concept of farm animal welfare (Vanhonacker *et al* 2008). The selection of issues was organised in such a way that each of the seven dimensions constituting the citizens' (perceptual) interpretation of the concept of farm animal welfare, as described by Van Poucke *et al* (2006), was represented by at least one item. These dimensions were: 'Animal Health'; 'Engagement in Natural Behaviour'; 'Feed and Water'; 'Housing and Climate'; 'Human-Animal Relationship'; 'Suffering and Stress' and 'Transport and Slaughter'. Another group of issues involved meat product characteristics, such as taste and price of pork as well as food safety-related matters, such as hormones, residuals and food safety itself. The list was further completed with single items (eg quality of the information, environmental impact, etc). For each of the items, respondents were asked to express their level of concern on a seven-point Likert scale that ranged from 'not at all concerned' (1) to 'very concerned' (7). Secondly, respondents were asked if they were aware of piglet castration in Flemish pig production and if 'yes', to formulate the reason for this practice, using an open-ended question. In this introductory part, nothing was asked explicitly about immunocastration.

Following on, in the general portion, the respondents were provided with printed information about immunocastration. The information message included three components. The first included a general description as to why castration was performed, the manner in which it is currently practised (surgical castration without anaesthesia), and a short explanation about immunocastration. The second component consisted of a description of the advantages of immunocastration. Benefits mentioned in the message referred to a reduction of pain and stress when compared to surgical castration, a reduction of aggression and sexual behaviour compared to entire males, a better feed conversion ratio compared to barrows and sows, and the reassurance that such meat is safe for the consumer. In the third component, the major downsides/risks associated with immunocastration were given, in terms of the danger of self-injection, the costs associated with injecting pigs, the fact that the vaccine is yet to be registered by the EU, and the uncertainty surrounding consumer acceptance (Table 2). While the first component of the message was provided to all respondents, the second and third parts were only presented to subsamples of the overall sample. In total, four different types of questionnaire were distributed. In a first message condition, only the general part was

Table 1 Percentages of socio-demographic characteristics of the survey participants (n = 225).

Characteristic	Percentage
<i>Gender</i>	
Male	55.0
Female	45.0
<i>Family size</i>	
1	5.4
2	28.1
3	14.9
4	28.1
5+	23.5
<i>Age</i>	
< 26 years	38.6
26–40 years	24.5
41–54 years	23.6
55+ years	13.2
<i>Living environment*</i>	
Rural	43.4
Urban	36.7
Neutral	19.9

* Living environment was self-assessed by the respondents on a seven-point scale, ranging from 'rural' (1) to 'urban' (7). Percentages represent response categories 1, 2 and 3 for rural; 5, 6 and 7 for urban and response category 4 for neutral.

provided. The subsample that received this first version functioned as the control group in the study (below, this subsample is referred to as 'control'). In the second condition, benefits were shown together with the control message ('benefits'). In the third condition, the downsides were given together with the control message ('risks'). Finally, the fourth message condition provided the full picture, ie it contained the general part and both the possible benefits and risks from immunocastration relative to surgical castration without anaesthesia ('full info'). Message conditions were assigned randomly to the survey participants.

After exposure to the previously described message conditions, questions were asked specifically about attitudes and self-reported willingness-to-pay, related to immunocastration and meat from immunocastrated pigs. First, respondents were probed for their general attitude towards immunocastration as an alternative to the present practice of surgical castration. The measurement scale was a seven-point Likert scale, ranging from 'much worse (than surgical castration)' (1) to 'much better' (7). Secondly, immunocastration was

Table 2 Message conditions tested in the survey: message content and number of respondents (n) exposed to each message.

Message condition	Message content	n
Control	Why are male piglets castrated? – To avoid boar taint Current method of castration – Surgical castration Potential alternative – Immunocastration	58
Benefits from immunocastration	Control+ Pain and stress reduction Reduction of level of aggression and sexual behaviour Better growth performance No risks for food safety	53
Risks from immunocastration	Control+ Danger of self injection Extra costs (labour and vaccine) Vaccine not yet authorised Uncertainty about consumer acceptance	57
Full content message	Control + Benefits + Risks	57

evaluated against surgical castration on a list of process characteristics and pork attributes, applying the same seven-point scale. Thirdly, consumers were asked to report their willingness-to-pay for meat from immunocastrated pigs for different levels of price premiums on a seven-point probability scale, ranging from 'very unlikely' (1) to 'very likely' (7).

Statistical analysis

Data were analysed using SPSS 15.0. Frequencies and means (\pm SD) are presented in table form. Factor analysis using principal components and varimax rotation is applied in order to analyse the association between the reported concerns of consumers regarding characteristics of practices in the pig production chain. A factor analysis is useful to identify common underlying dimensions (factors) that consist of items (in this instance concerns) that are strongly inter-related (Hair *et al* 2006). The selection of factors was based on eigenvalues (> 1 as threshold), while factor loadings were used to interpret the meaning of the resulting factors. Cronbach's alpha was used to decide upon internal reliability consistency. The threshold value for a satisfactory construct is 0.6, which denotes that the different items measure one single construct and therefore may be aggregated. Aggregation was carried out by averaging the scores across issues assigned to a specific factor. Bivariate analyses through comparison of mean scores, including independent samples' *t*-tests and ANOVA *F*-tests with Bonferonni and Dunnett's T3 *post hoc* comparison of mean scores, were used to assess the impact of the different message conditions on interval scaled variables related to consumer attitudes and self-reported willingness-to-pay.

Results

Consumer awareness of piglet castration

Half of the respondents reported they were aware of the fact that male piglets are castrated. This group is further termed as the 'aware group', the other half as the 'unaware group'. From the aware group, 78% was able to report that the reason for this practice was related to meat quality, with the vast majority referring to the odour of the meat and 27 respondents (12%) explicitly mentioning boar taint. Taking together the 50% indicating an awareness of piglet castration and the 78% denoting the correct reason, it can be concluded that approximately 40% of our sample is well-informed on the topic. Incomplete and/or wrong answers most frequently pertained to the notion that castration was carried out primarily to reduce the level of aggression, to control reproduction and to avoid energy use from reproduction and leave more energy for growth and other production parameters.

Consumer concerns about pig production practices

Factor analysing the concern scores related to the list of characteristics of and practices in the pig production chain, yielded a four-factor solution based on eigenvalues > 1 . Those concerns that either did not load high (no loadings above 0.5) on any of the retained factors or that had loadings on multiple factors were excluded from the analysis (Table 3). Total variance explained was 74.0%. The first factor comprised production system-related animal welfare concerns and explained the major part of the variance in the original data. At least one issue from each of

Table 3 Flemish consumer concerns related to pig production (n = 225).

	Factor 1	Factor 2	Factor 3	Factor 4	Mean (\pm SD)
Space availability	0.828				5.12 (\pm 1.48)
Slaughter without pain and stress	0.776				5.27 (\pm 1.56)
Barn climate	0.776				5.04 (\pm 1.50)
Transport climate	0.775				4.96 (\pm 1.65)
Stress	0.756				5.06 (\pm 1.54)
Animal welfare	0.744				5.11 (\pm 1.54)
Farmer-animal contact	0.730				4.94 (\pm 1.69)
Farmer skills	0.719				5.00 (\pm 1.72)
Mortality	0.698				5.38 (\pm 1.55)
Type of housing	0.695				4.61 (\pm 1.65)
Disease	0.682				5.56 (\pm 1.44)
Natural behaviour	0.669				4.77 (\pm 1.59)
Feed	0.639				5.32 (\pm 1.60)
Medication residuals		0.871			5.48 (\pm 1.60)
Use of hormones		0.862			5.56 (\pm 1.64)
Food safety		0.741			5.55 (\pm 1.61)
Genetic modification		0.726			4.56 (\pm 1.71)
Tail docking			0.839		4.17 (\pm 1.77)
Tooth resection			0.834		4.15 (\pm 1.76)
Castration			0.777		4.14 (\pm 1.73)
Price of meat				0.817	4.74 (\pm 1.61)
Taste of meat				0.681	5.37 (\pm 1.55)
Eigenvalue*	11.2	2.7	1.3	1.1	
Explained variance (%)	34.9	16.3	14.1	8.7	
Cronbach's alpha	0.96	0.83	0.92	0.63	
Mean (\pm SD) Total sample	5.10 (\pm 1.28)	5.31 (\pm 1.40)	4.17 (\pm 1.63)	5.05 (\pm 1.35)	
Mean (\pm SD) Aware group	5.05 (\pm 1.29)	5.21 (\pm 1.54)	4.28 (\pm 1.73)	4.95 (\pm 1.45)	
Mean (\pm SD) Unaware group	5.14 (\pm 1.23)	5.40 (\pm 1.24)	4.03 (\pm 1.50)	5.15 (\pm 1.24)	

Items not included because of low or dual factor loadings: Import of foreign meat (4.63 [\pm 1.69]); Environmental impact (4.88 [\pm 1.62]); Quality of information (4.83 [\pm 1.59]); Intensive character (4.54 [\pm 1.54]); Growth rate (4.35 [\pm 1.53]).

* Only factors with an eigenvalue above 1 are reported.

the seven dimensions that constitute the citizen's interpretation of farm animal welfare (see Van Poucke *et al* 2006) was strongly correlated to this factor. The second factor corresponded with food safety concerns. Together with the item food safety itself, concern related to hormones and medication residues was categorised in this factor. Interestingly, concern regarding genetic modification also correlated significantly with the food safety factor. Next, concern for

some specific mutilations — among them piglet castration — was ranked as a third factor, separate from the factor dealing with other production system-related animal welfare concerns. Yet it is noteworthy that concern about castration also correlates with the factor of animal welfare concerns (factor loading of 0.416), thus it is not perceived as being completely unrelated to the other production system-related animal welfare concerns. The fourth factor

Table 4 Consumer perception of immunocastration (IC) as worse (1) or better (7) than traditional surgical castration, depending on the information condition to which consumers were exposed.

	Mean (\pm SD)	Message condition				ANOVA F-test (P-value)
	n = 225	Control (n = 58)	Benefits (n = 53)	Risks (n = 57)	Full info (n = 57)	
General attitude IC	4.77 (\pm 1.44)	4.95	4.58	4.98	4.55	0.240
Avoiding boar taint	4.23 (\pm 1.18)	4.15 ^{ab}	3.85 ^a	4.57 ^b	4.30	0.019
Meat quality (sensory)	4.06 (\pm 1.11)	3.91	3.81	4.27	4.21	0.090
Profit per pig	4.08 (\pm 1.23)	3.64 ^a	3.65 ^a	4.65 ^b	4.32	< 0.001
Type of labour for farmer	4.33 (\pm 1.20)	4.40 ^a	4.21 ^a	4.64 ^b	4.05	0.063
Farm profitability	4.10 (\pm 1.17)	3.84 ^a	3.92 ^a	4.65 ^b	3.98	0.001
Food safety	3.82 (\pm 1.22)	3.80 ^{ab}	3.29 ^a	4.31 ^b	3.82	< 0.001
Animal welfare	5.44 (\pm 1.31)	5.45	5.53	5.33	5.45	0.889
Consumer acceptance	4.83 (\pm 1.35)	5.06	4.48	5.11	4.64	0.041*
Workload for farmer	4.17 (\pm 1.32)	4.31	3.88	4.55	3.93	0.025*
Competitiveness of sector	4.16 (\pm 1.16)	4.11	3.98	4.51	4.02	0.069
Affordability for consumer	3.69 (\pm 1.02)	3.51	3.58	3.95	3.71	0.128

* Despite significant ANOVA F-tests, Bonferonni and/or Dunnett's *post hoc* tests did not indicate significant differences between the mean scores.

^{ab} Scores in the same row with different superscripts differ significantly ($P < 0.05$).

(eigenvalue just above the threshold) consisted of concern related to the end product's price and taste — two important product attributes — which reflect pork meat concerns.

Mean values for the factors indicated that the highest concern was for food safety issues, followed by animal welfare and pork meat concerns. Concern about animal mutilations was attributed a mean score of around the scale's mid-point. Differences in the factors' mean values between the aware and unaware group were not significant ($P > 0.05$).

Regarding the concern scores for the full list of characteristics of practices in the pig production chain, we notice that Flemish consumers are suspicious about the use of hormones and residuals and about food safety in general (Table 3). Also, the pork meat's taste is attributed a high concern score. The lowest mean concern score — though still on the positive side of the scale — was reported for piglet castration, followed by the two other animal mutilations incorporated in the study.

Impact of the information message related to immunocastration

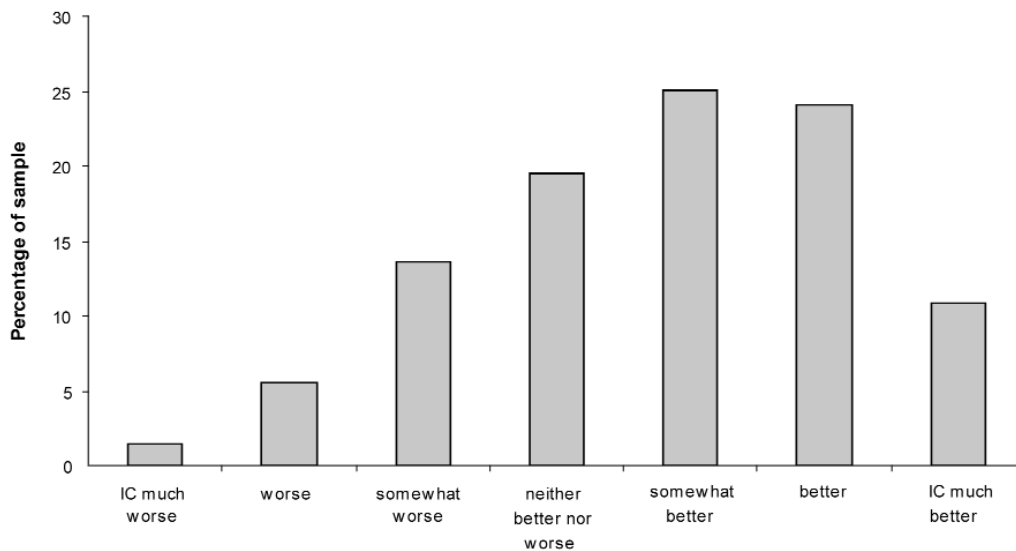
Message condition did not have a significant impact on the respondents' general attitude towards immunocastration (Table 4) nor on their self-reported willingness-to-pay for meat from immunocastrated pigs ($P > 0.1$). Conversely, some significant effects of message condition were found regarding more specific aspects of immunocastration versus surgical castration (Table 4). However, these differences did not provide a consistent and coherent picture. For instance,

the message condition where only risks were communicated yielded a better comparative evaluation for immunocastration in terms of farm profitability and farmer's profit, despite the fact that immunocastration was identified with possible extra costs. Thus, it is doubtful whether these differences are due to the message condition or to differences in the characteristics of the respondents exposed to a particular message condition.

Consumer attitude towards immunocastration

Given that the message condition did not affect general attitude or stated willingness-to-pay towards immunocastration, the data were merged for further analyses. In general, respondents evaluated immunocastration slightly better than surgical castration (Table 4), with 60% of the sample indicating a preference for immunocastration over surgical castration (ie score > 4) (Figure 1). The respondents believed immunocastration to be superior to surgical castration in terms of animal welfare (Table 4). Also, respondents indicated a higher consumer acceptability for immunocastration. Further evaluations significantly in favour of immunocastration in consumers' perception pertained to the type of labour for the farmer and the avoidance of boar taint. In contrast, food safety and price were evaluated more negatively for immunocastration compared to surgical castration. Workload for the farmer, competitiveness of the sector, farm profitability, profit per pig and meat quality were not pronounced in favour of

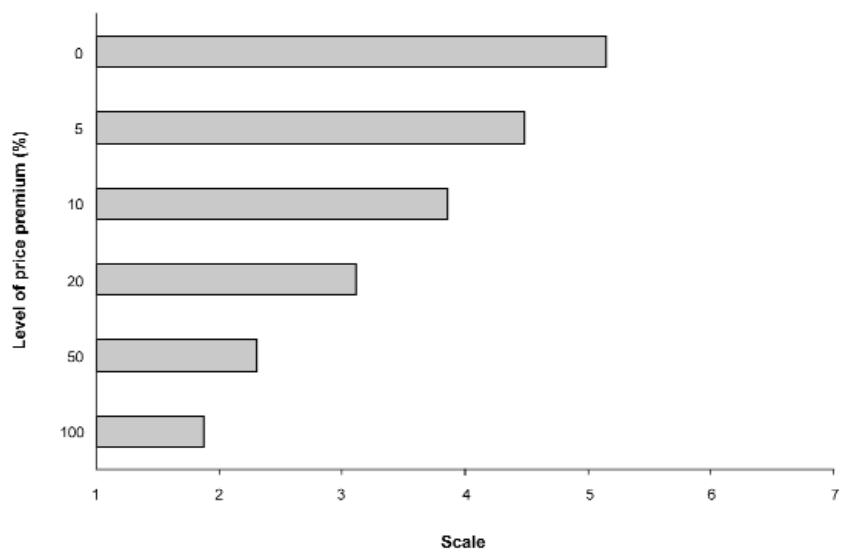
Figure 1



General attitude of consumers towards immunocastration (IC) relative to attitude towards the traditional practice of surgical castration. Answers are registered on a seven-point scale ranging from immunocastration perceived as 'much worse' to 'much better'.

Figure 2

Self-reported willingness-to-pay (WTP) a price premium (expressed as percentage over the price conventional pork) for meat from immunocastrated pigs. Self-reported WTP is measured on a seven-point scale ranging from 'very unlikely to buy' (1) to 'very likely to buy' (7).



either one of the practices (ie mean value did not differ significantly from the scale's mid-point). The respondents' answers were mainly characterised by a high number of respondents positioning themselves in the middle of the scale. Such answering behaviour reflects either that people judge both methods truly equivalent or that they express uncertainty and/or unawareness. In particular, more than half of the sample (52.8%) positioned themselves at the scale's mid-point for the issue attribute of sensory meat quality.

Self-reported willingness-to-pay for pork from immunocastrated pigs

Self-reported willingness-to-pay for meat from immunocastrated pigs was assessed for different levels of price premiums as compared to conventional pork, ranging from an equal price to double. Respondents stated that they preferred meat from immunocastrated pigs if the meat is offered at the same price (positive reported likelihood of purchase) (Figure 2). On average, a price premium of five percent still corroborates with a positive probability of

buying meat from immunocastrated pigs (ie mean value > 4). Further price premiums result in a negative purchase probability (ie mean value < 4).

Discussion

Research related to alternatives to surgical castration of male piglets without anaesthesia is extremely topical in various research fields. This interest originates from the debate that surgical castration currently faces, a debate that is also kept alive by animal welfare organisations (eg 'Pigs in Pain' campaign by GAIA in Flanders). From the different alternatives currently available and/or under development, this study focused on immunocastration or the so-called 'vaccination method'. Motivations underlying this choice pertain to the fact that a vaccine is currently available and in use in several countries, and authorisation of the vaccine for the EU market is expected in 2009. Thus, immunocastration can be seen as a possible short-term solution. Also, there is no need for surgery, thereby yielding positive implications for animals' welfare, integrity and health. In addition, this method gives promising results in terms of animal growth and feed efficiency (eg Dunshea *et al* 2001; Turkstra *et al* 2002; Cronin *et al* 2003; Jaros *et al* 2005; Prunier *et al* 2006).

Successful implementation of novel methods and practices, such as immunocastration, is often believed to depend upon consumer acceptance (Frewer *et al* 1997). Thus far, consumer studies about immunocastration have tended to focus more on sensory issues (eg Font i Furnols *et al* 2008) instead of attitudes, perceptions and purchasing behaviour. In this context, an exploratory research design was constructed with consumers' awareness, attitudes, perceptions and beliefs as central themes. Our method of data collection allowed a substantial amount of data to be collected in a limited amount of time, but also implied that the sample was not statistically representative of the total Flemish population.

An initial significant finding was low consumer awareness regarding piglet castration. This corresponds with consumers and citizen alienation from livestock production and livestock production practices (Harper & Henson 2001). An (ever-) increasing degree of urbanisation and industrialisation of livestock production creates a situation whereby consumers and citizens become less and less aware of how animals are actually reared (De Tavernier *et al* 2005). As such, opinions are strongly shaped by perceptions and (often distorted) external information, rather than on facts and genuine experiences. Increasing awareness — thus decreasing the distance between perception and reality — however, is not simply an issue of providing additional information. A considerable number of people, for instance, consume meat, ignoring the fact that this originates from an animal raised for human consumption ('voluntary ignorance'; Harper & Henson 2001). Also, buying food is most often a routine process, in which people are not searching extensively for information. This is strengthened by the present information era in which consumers are overloaded with informa-

tion (Verbeke 2005). In addition, large standard deviations for the reported concerns reflect a substantial degree of heterogeneity in the population regarding the impact of animal welfare, which also impacts on attitude formation and food-purchasing behaviour (eg Vanhonacker *et al* 2007). As such, communication efforts should be well-considered and directed at the right target audiences.

In addition to limited awareness, consumers expressed moderate concern regarding piglet castration, especially when compared to other production system-related animal welfare concerns. Moreover, castration, together with the other animal mutilations incorporated in the survey, emerged as a separate factor in the factor analysis, apart from other welfare-related concerns. This suggests that people perceive these issues as being different from other, common, welfare-related practices in pig production. The greatest concerns in our sample pertained to issues of food safety. The use of hormones and worries regarding medication residues trouble consumers and reflect that the different scandals and crises that have hit Flemish livestock production are still prominent in consumers' minds. Also, the categorisation of genetic modification as part of the food safety factor reflects the wariness about potential safety implications of biotech in livestock production (Frewer *et al* 1997). These findings suggest that consumers are extremely vigilant about livestock production practices that may impact (real or perceived) end-product safety.

The second main finding was that, in the present study, consumer acceptance of immunocastration does not seem to be a problem. Immunocastration was received significantly more favourably than surgical castration. This degree of acceptability seemed to be largely related to the improvement the method has in terms of animal welfare. As a consequence, the uncertainty expressed in some of the literature towards the acceptance of immunocastration at the consumer level cannot be confirmed in this study. Nonetheless, one should bear in mind that consumer acceptance is not equal to actual consumer behaviour. Reasons that explain the possible discrepancy between acceptance and actual purchasing behaviour relate to animal welfare not being a priority product attribute in the consumer decision-making process of pork, since this attribute is traded off against other quality characteristics, such as price, taste, safety and healthiness (Verbeke & Viaene 2000). In general, animal welfare is of secondary importance and influences purchasing choices only when other criteria have been fulfilled (Harper & Henson 2001; Ingenbleek *et al* 2006). In our sample, meat from immunocastrated pigs was perceived as being more expensive and less safe than from surgically-castrated pigs, while respondents' perceptions about taste did not differ between meat from immunocastrated or surgically-castrated pigs. These findings probably explain why the favourable attitude expressed by our respondents towards immunocastration is not translated into a strong self-reported willingness-to-pay.

It is very important to emphasise that these results reflect consumer perceptions at the actual time of the survey and to be aware that they can shift and fluctuate over time. Thus, were meat from immunocastrated pigs about to be introduced, it would be important to communicate clearly with consumers regarding the impact on price, food safety and taste. It will be especially important to avoid negative and/or incorrect information concerning these issues, given the disproportionately large impact of negative publicity related to food safety issues (Verbeke & Ward 2001; Verbeke & Vackier 2004).

Finally, the communication experiment in which the impact of an information message was tested on consumers' attitude and behaviour towards immunocastration resulted in non-significant effects. There could be several reasons for this outcome. Firstly, the message was merely rational, requiring a substantial degree of active and rational information processing from the recipient audience; it may have been that an emotive message or the provision of images or a video would have triggered a greater impact. Secondly, as the questionnaires were completed online, outwith the control of an interviewer, we do not have any information regarding the extent to which the message was effectively read by the respondents. Given the rather low awareness and concern about piglet castration in our sample, one can expect a low degree of issue involvement. Typically, low issue involvement results in a low level of active reasoning and a low level of conscious information processing (Mittal & Lee 1989; Verbeke & Vackier 2004). Consumer involvement is also important for the formation of beliefs, attitudes and intentions (Verbeke & Vackier 2004). The reported low involvement implies that attitudes and beliefs are not strongly shaped and can shift in either direction depending on the individual, the context and the information received. This illustrates the importance of avoiding incorrect and negative publicity and of encouraging communication that can shift consumers' beliefs and attitudes in a favourable direction, especially on the product attributes that strongly impact on consumer purchase behaviour and where uncertainty is present at consumer level.

Animal welfare implications

Immunocastration is generally regarded as a more animal-friendly method of dealing with the problem of boar taint than the current practice of surgical castration without anaesthesia. One of the major concerns that is often expressed about this alternative method, though, is whether or not consumers will readily accept and purchase pork from immunocastrated animals. Findings from the present survey confirm the few other studies that have investigated this topic from a consumer perspective. More specifically, consumer acceptance of immunocastration is not likely to be a problem. Future research should address whether, and to what extent, this response behaviour will translate to consistent purchase behaviour, ie consumer preference and market-place choice for pork from more animal-friendly pig production.

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