Russian and Chinese consumers' acceptability of boar meat patties depending on their sensitivity to androstenone and skatole

M. Font-i-Furnols [a,*], M.D. Aaslyng [b], G.B.C. Backus [c], J. Han [d], T.G. Kuznetsova [e], N. Panella-Riera [a], A.A. Semenova [e], Y. Zhang [d], M.A. Oliver [a]

[a] IRTA-Product Quality, Finca Camps i Armet, 17121, Monells, Girona, Catalonia, Spain
[b] Danish Meat Research Institute (DMRI), Danish Technological Institute, Gregersensvej 9, DK-2630, Tåstrup, Denmark
[c] Connecting Agri and Food, Oostwijk 5, 5400 AM Uden, The Netherlands
[d] Nanjing Agricultural University, No. 1 Weigang, Nanjing, Jiangsu Province 210095, PR China
[e] Gorbatov's All-Russian Meat Research Institute (VNIIMP), 26, Talalikhina Str., 109316 Moscow, Russia

ARTICLE INFO

ABSTRACT

The aim of this work was to study the sensitivity of Chinese and Russian female consumers to androstenone and skatole and to identify their preference for pork patties from entire male pigs compared with those from castrated pigs. One-hundred-twenty women in each country were enrolled. The sensitivity of the consumers to both compounds was tested using smell strips and triangular tests. Pairwise tests were performed comparing patties from castrated male pigs with patties from boars with different levels of androstenone and skatole. Approximately 70% of the Russian and 60% of the Chinese consumers were sensitive to skatole and 37% and 32% were sensitive to androstenone, respectively. Nevertheless, a higher percentage of sensitive Russian consumers compared to Chinese consumers disliked the smell of both compounds. In Russia, the consumers' preferences were higher for patties with low levels of both compounds, while no differences were found in China. In both countries, consumers who were sensitive to skatole also preferred patties with low levels of both compounds. Thus, the levels of androstenone and skatole affect boar patty preferences.

© 2016 Elsevier Ltd. All rights reserved.

1. Introduction

In 2010, representatives of European farmers, the meat industry, and animal welfare NGOs signed a declaration of intentions in which they state their ambition to abandon the surgical castration of pigs by January 2018. The case for complete 'non-castration' poses risks due to consumers reducing their consumption of pig meat due to the presence of boar-tainted meat. Boar taint is a sensory defect characterized by an odd flavour and odour related mainly to the presence of two compounds, androstenone (Patterson, 1968) and skatole (Vold, 1970; Walstra & Maarse, 1970), which are mainly stored in the fat. Androstenone (androst-16-en-3-one) is synthesized in the testes, and its level depends on the breed, weight and maturity at slaughter, and management strategies (Bonneau, 1998; Claus, Weiler, & Herzog, 1979). Skatole (3-metilindole) is the product of the anaerobic degradation of tryptophan in the gut, and its level depends mainly on the feeding and rearing conditions as well as being related to the sex of the pigs (Bonneau, 1998; Doran, Whittington, Wood, & McGivan, 2002). Indole is also produced in the gut and stored in the fat, but its contribution to

boar taint is lower. The detection and rejection thresholds for these compounds are not clear and unique because they depend on several factors, such as the chemical measurement method, the sensitivity of the consumers, the type of product, and so on. Because the European Union is a large exporter of pig meat, it is of interest to know the consumers' preferences in these importing countries.

According to the FAO, in 2013 China produced 49% of all of the pigs in the world, although this percentage would be lower according to Yu and Abler (2014). With higher income levels, people in China eat more meat. With increasing consumption of pork in China, the importation of this meat in this country will increase. In Russia the situation is different. This country produces 2% of the world pig production (FAOSTAT, 2014). Until the Russian border closed in January 2014, Russia imported a significant amount of pork, but now the imports have abruptly decreased. Nevertheless, Russia will probably remain a potential importer of pigs from European countries. Moreover, all carcasses and pork meat in Russia are evaluated organoleptically (shred meat, cook to an 80–85 °C internal temperature, and evaluation of the smell of the broth and meat by a trained panellist) in the laboratory to find off-odours before using it for further processing or commercialization. Thus, because the introduction of boars can increase the presence of off-odours, there can be a problem in its commercialization if no sorting is carried out. In fact,

---

changes in production characteristics are related with changes in the demands and preferences of importing countries (Oh & See, 2012). Because 100% of males are surgically castrated in China and Russia and their consumers are not used to the boar taint odour and flavour, the introduction of boar meat may modify the acceptability of pork by consumers and consequently the importation of European pork if no quality assurance measures are put in place.

The aim of this work was (1) to study the sensitivity of Chinese and Russian female consumers to androstenone and skatole and (2) to identify Chinese and Russian consumers' preference for and acceptability of pork patties from entire male pigs compared with those from castrated pigs.

2. Materials and methods

2.1. Consumers

A total of 240 women participated in the consumer test in two countries, Russia (n = 120) and China (n = 120). In Russia, the study was performed at the Gorbatov's All-Russian Meat Research Institute in Moscow, and in China, it was performed at the Nanjing Agricultural University in Nanjing (Jiangsu province) early in 2014. In Russia, the consumers were recruited according to the age and sex distribution of the city as well as their regular consumption of meat (including pork) from internal (institute employees) and external (customers) sources. In China, consumers were enrolled with the help of residential communities in the eastern and southern areas of Nanjing following the female distribution by age of the city (data from the 6th National Population Census carried out in 2010).

The test was divided into three parts that were conducted in the following order: meat evaluation; sensitivity smell test; and a questionnaire including questions on demographics, meat consumption and whether they liked pork.

2.2. Demographic and preferences questionnaire

The demographic characteristics of consumers (age and education level) were collected as well as information about their level of responsibility for cooking main dishes at home. Additionally, they were asked to indicate if they had a cold or allergy at the time of the test. Their preference for the consumption of several types of meat was also asked as well as the frequency of consumption of pork in hot or cold dishes. Finally, consumers were asked to answer whether they had a dissatisfactory experience with pork in the last two months, and if so, they were asked to choose one or several reasons from a list including the following: bad taste, bad odour, too fatty, high losses when cooking/fluid when cooking, tough, low fat/marbling, too light/too dark colour, rancid and spoiled.

2.3. Meat classification and preparation

For this work, meat samples from castrated pigs and meat from three boars with different levels of boar taint were obtained at Danish Crown, Ringsted (Denmark). Boar meat was initially selected according to analytical measurements of the skatole equivalence (and indole) (Mortensen & Sørensen, 1984) using a colorimetric methodology and sensory evaluation of the back fat tissue in a sensory lab (human nose) on the day of slaughter (Meinert, Bejerholm, & Støier, 2011). Later on, androstenone was chemically determined in back fat tissue by means of the method described by Hansen-Møller (1994) with the modifications detailed by Aaslyng, De Lichtenberg Broge, Brockhoff, and Christensen (2015). In brief, the compounds were extracted from the back fat with methanol by homogenization followed by centrifugation after chilling. The extracts were analysed by HPLC using fluorescence detection using a Hypersil ODS column (4 × 100 mm, 3 μm). Fluorescence detection was applied with excitation at 285 nm and

emission at 340 nm for the first 12.0 min (indole and skatole), and then, the wavelengths were changed to excitation at 346 nm and emission at 521 nm (dansylhydrazones of androstenone and androstanone). The analytical contents of androstenone and skatole analysed in the neck fat tissues are presented in Table 1. The fore-end, neck and back fat were excised the day after slaughter and frozen. The left side of each pig was shipped to China, while the right side was shipped to Russia.

Patties were prepared using the meat and fat from these pigs. To mimic the worst situation regarding boar taint, the consumers evaluated patties with a high amount of fat, that is, the tissue where androstenone and skatole is accumulated. For this purpose, 20% of fat was added to lean meat, minced (whole size of 2 mm) and mixed. The mixture was frozen at −20 °C in small bags until the day before the test, and then, the mixture was thawed at 4 °C. On the day of the test, 220 g of each mixture was used to prepare two hamburger patties with a patty-press (Ø 110 mm). Patties were stored at 4 °C until their use.

Patties were fried in preheated non-stick pans until they reached an internal temperature of 81 °C (approximately 10 min). Patties were turned every 2 min to allow a more homogeneous cooking. Each pan was used exclusively for one of the four different types of patties (according to the androstenone and skatole levels of Table 1) to avoid odour and taste contamination. Cooked patties were identified with a 3-digit code and served immediately to the consumers to ensure a serving temperature higher than 70 °C.

To guarantee reliability and consistency of the test in China and Russia, the protocols used were the same in both countries, and project teams of the two countries were trained beforehand on the preparation of the patties and the testing procedure.

2.4. Meat evaluation

A total of 15 and 10 sessions were performed with 8 and 12 consumers in Russia and China, respectively. Consumers evaluated 4 pairs of patties, each pair served monadically. Both patties of the first pair were from castrated pigs to familiarize the consumers with the evaluation procedure for each pair of samples and to reduce a first order effect on the assessment of the boar meat. The following pairwise comparisons were each composed of one patty from a castrated pig and one patty from one type of boar. Each consumer evaluated all three types of boars, and each patty was split in 4 pieces that were evaluated by 4 consumers. The serving order was balanced for the location of the boar patty in the pair as well as for the order of the pairs across consumers with two (in Russia) or three (in China) serving designs in each session.

For each pair, consumers' were asked to choose the preferred sample for odour and flavour separately. Then, they were asked to score how much they liked each sample of the pair on a 9-point hedonic scale from "like extremely" (9) to "dislike extremely" (1). The intermediate level "neither like nor dislike" (5) was removed to stimulate consumers to give a more specific answer rather than the neutral one (Guerrero, 1999).

Table 1
Levels of androstenone, skatole and indole in back fat analysed in the fat tissue of the three boars for the consumer study.

	Compound level [mg/kg back fat tissue]		
	Androstenone	Skatole	Indole
LALS	0.84	0.043	<0.03
HAMS	2.25	0.213	0.211
HAHS	2.43	0.497	0.059

LALS: low androstenone, low skatole; HAMS: high androstenone and medium skatole; HAHS: high androstenone and high skatole.