SHIFTING SENSORY THRESHOLDS OF PRE-COOKED ENTIRE MALE MEAT USING THE MARINATING TECHNOLOGY.

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Background

The government of Norway has decided that from year 2009 castration of male pigs will no longer be accepted. Entire males are associated with an unpleasant taste and smell largely due to the presence of skatole and androstenone. The political decision in Norway has urged a need for updating the knowledge in selected areas aiming at preventing the occurrence of boar tainted meat in the marked. Such areas are the development of new, robust classification methods at the slaughterhouse, but also achieving more knowledge on processing possibilities has been encouraged.
The most common approach for processing of entire male meat is to comminute the meat and then « dilute » it to an undetectable concentration of androstenone and skatole. This works well for comminuted meat products like fresh and fermented sausages (Bonneau and Squires, 2000). However, it is believed that a substantial fraction of the entire males will be downgraded if the castration ban becomes effective. There is therefore be a need for recipes that can work well also for intact muscles. Needle injection is the most efficient technique for flavour adjustment of intact meat. It has, among other, been suggested as an efficient technology for modifying pre rigor off-flavour (Sindelar et al., 2003) plus characteristic, strong lamb flavour (Young and Ho, 1998).

Objectives

The work reported here was conducted in order to identify marinades that could be efficient with respect to reducing the sensation of boar taint.

Materials and methods

Materials: Neck chops were collected from a commercial slaughterhouse. Only samples having skatole contents > 0.21 ppm in the neck fat were selected. No attention to breed was made. 12 entire males and 4 castrates were selected one-day post-mortem. Small samples were removed for pH, fat content and androstenone determination. Thereafter the necks were vacuum-packed and frozen at -40°C. A few weeks later the samples were thawed, injected, heated and later served for sensory analysis.
Methods:
Marinades for injection: All marinades were laboratory-made based on chosen ingredients. Ingredients are given in Table 1. Water is not listed (adds up to 1000 gram). Other ingredients (see Table 1) were used in smaller quantities and appeared post-sensory testing as not relevant, and brand names were not given. Four marinades were selected among 18 different marinades by a subjective sensory panel for further evaluation by objective sensory profiling (Løvlund, 2002). The criterion of selection was that the marinades should provide tasty meat as well as reduce the sensation of boar taint. Only three of the marinades revealed interesting properties with respect to affecting boar taint, and these marinades are described in Table 1.
Analysis of pH, fat, androstenone and skatole contents: pH was measured with a Beckman ϕ31 pH meter. The fat content was measured on neck meat slices using low field Nuclear Magnetic Resonance (NMR) measurements on homogenised and dried meat (Pedersen et al., 2001). Skatole was determined using an extraction method where skatole is extracted from fat in tris-acetone and then reacted with a colour reagent before spectroscopic quantification (Mortensen and Sørensen, 1984). Androstenone was determined using a fat extraction method followed by the use of a commercial immunoassay kit (Riedel deHaen, Seelze, Germany).
Preparation of samples for sensory analysis: The meat samples were injected with 20% (w/w) increase. Thereafter the meat samples were packed individually in cook-shrink bag and chilled overnight before being

cooked to an internal temperature of 71°C. The samples were chill-stored for 10 days and then re-heated and served to a trained sensory panel. The profile used was the one defined by Dijksterhuis et al. (2000) where it is reported that androstenone relates mostly to urine, and skatole relates mostly to manure. Their profile was modified to include characteristic flavours describing the ingredients of the marinades. The panellists used intensity scores from 1-9; 9 meaning highest intensity score.

Statistics:

The data were analysed using Minitab version 14 (www.minitab.com). The routines used for analysis of variance were: General linear method for modelling and Tukey's test for comparisons.

Table 1. Important ingredients in the marinades injected in the different entire male neck muscles.

Ingredient (in grams pr kg marinade)	Marinade 1	Marinade 2	Marinade 3
Salt (NaCl)	40.0	59.4	52.8
Sodium nitrite	0.24	0.36	0.32
Ascorbate			1.6
Phosphate (E451, E450)(as P_2O_5)	14.3	18.8	16.9
Soy sauce –reduced salt (Kikkoman Corp.)	250.0	-	-
Dextrose	12.8	16.9	17.5
Fructose	3.7	3.7	3.3
Liquid smoke (Wright's, USA)	3.7	9.9	-
Garlic powder (E.H.Woree, Germany)	-	-	2.2
Oregano, oleoresin (Kalsec, USA)	-	-	0.5
Paprika, extract (Chr.Hansen, Spania)	-	1.2	-
Others	Lemon pepper	-	Tomato, onion and bacon flavour

Results and discussion

The 16 animals used were characterised as shown in Table 2. The table shows that a wide range of androstenone (A) and skatole (S) values was obtained. The correlation between A and S was low (r=0.34). To most consumers sensory threshold values for S and A of entire males would be above 0.2-0.25 mg/kg and 0.5-1.0 mg/kg, respectively (Bonneau and Squires, 2000).

Table 2. Characteristics of the entire males and castrates used.

Samples (no)	Weight (kg)	pH	Fat range (%)	Androstenone (mg/kg)	Skatole (mg/kg)
Entire males (12)	70.6-186.1	5.64-6.22	5.0-12.4	0.8 - 4.0	0.23-0.68
Castrates (4)	72.1- 86.2	5.76-6.15	13.3-18.9	0.08-0.10	0.03-0.06

The manure taste related most strongly and significantly to skatole while the urine taste related most strongly and significantly to androstenone. This agrees with previous investigations (Dijksterhuis et al., 2000). The taste and smell attributes of manure or urine were correlated (r > 0.89), and only the taste attributes were therefore chosen for presentation here.

Figure 1 shows the taste attributes with the larger standard deviations; i.e. for those taste attributes the panellists used the intensity scale to a larger extent than for other attributes.

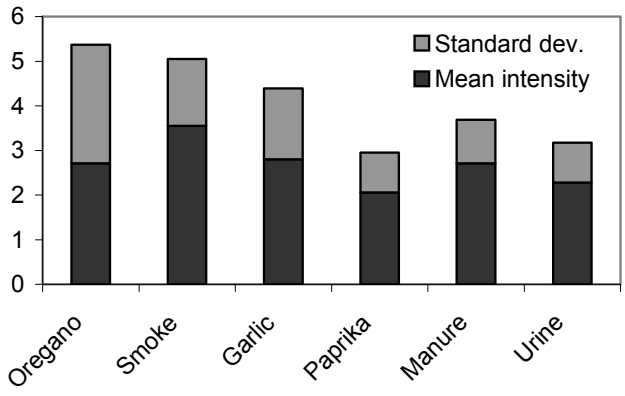

Figure 1. Mean intensity and standard deviation of different important sensory taste attributes for the 16 neck chops used (4 marinades tested).

Table 3. The intensity scores for manure and smoke taste for the 16 neck chops.

	Taste attribute	Castrates	S: 0.21-0.3 ppm	S: 0.3- 0.4 ppm	S: 0.4 -0.68 ppm
Marinade 1	**Smoke** **Manure**	**2.8** **2.1**	**2.6** **2.4**	**3.0** **2.4**	**2.6** **2.9**
Marinade 2	**Smoke** **Manure**	**6.0** **1.8**	**6.1** **1.8**	**6.0** **2.0**	**5.5** **2.3**

Marinades 1 and 2 were good at reducing manure taste. There was a significant ($p < 0.05$), and negative correlation between smoke taste and manure taste; i.e. the presence of liquid smoke appeared to be important with respect to reducing the taste of manure. Marinade 2 was significantly better ($p = 0.02$) at reducing the taste of manure than was marinade 1. Paprika also tended to reduce taste of manure but appeared much less successful compared to liquid smoke (results not shown). There was no significant difference between each skatole group. However, for marinade 1 the highest skatole group (S = 0.4-0.68 ppm) tended ($p = 0.06$) to have a higher taste of manure compared to the castrates. It was observed (not shown) that even for the castrates the panellists never rated these samples with intensity score exactly equal to 1.0 for taste of manure. The taste attribute manure therefore appeared somewhat difficult to exclude for all samples even for castrates.

The tastes of oregano, smoke and garlic were clearly detected, when these ingredients were added to marinades.

Marinade 3 gave the lowest mean intensity for taste of urine. Table 4 shows that the mean sensation of urine was reduced for marinade 3 compared to marinade 1 ($p = 0.008$). It was not possible to identify one single ingredient in marinade 3 that related significantly to androstenone level. The castrates had significantly lower taste of urine than the group that contained samples between 1-2 ppm of androstenone ($p < 0.03$). For the urine taste attribute the panellists gave intensity scores close to 1.0 for castrates, in particular for marinade 3.

Table 4. The intensity scores for oregano and urine taste for the 16 neck chops.

	Taste attribute	Castrates	A: 0.5 - 1 ppm	A: 1-2 ppm	A: 2-4 ppm
Marinade 1	**Oregano** **Urine**	**1.0** **1.6**	**1.3** **2.2**	**1.1** **2.5**	**1.3** **3.2**
Marinade 3	**Oregano** **Urine**	**6.3** **1.2**	**7.6** **1.7**	**7.7** **1.9**	**7.5** **2.3**

Conclusions

The sensory sensation of boar taint can be reduced by the addition of specific flavour components. Taste (or odour) of manure can be substantially reduced/eliminated by the use of liquid smoke. A marinade dominated by oregano and garlic flavour can reduce the sensation of urine taste.

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