SENSORY PERCEPTION OF PORK MEAT FROM BOARS PROCESSED BY DIFFERENT COOKING METHODS.

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Abstract

The objective of this study was determined the effects of Jerusalem artichoke supplementation period on the levels of boar taint compounds in boars, and effect the different cooking methods on sensory perception of musculus longissimus lumborum. Twenty-four intact male pigs were used for experiment and slaughtered at 154 days of age and average live 108.6 kg. Half of each sample of musculus longissimus lumborum was prepared by grilling and the remainder of the sample was vacuum-packaged and cooked in a water bath at 80 °C for 60 minutes. Six panellists evaluated this samples. Feeding Jerusalem artichoke 14 days before slaughter significant decreased (P = 0.006) the levels of skatole in adipose tissue. Although grilled meat achieved a better typical pork odour and flavour rating, vacuum cooked meat achieved lower and therefore better values for abnormal odour and flavour ratings. These results confirm that consumer preferences are influenced not only level of skatole in meat but also by levels of other substances released during the heat treatment. In short, the use of different heating methods affected boar meat perception.

Key Words: Boar taint; musculus longissimus lumborum; Jerusalem artichoke; sensory analysis; heating methods

Boars are already being used for the production of pork meat in some countries, however the occurrence of so called "boar taint" in this meat represents a significant problem (Zadinová et al 2016). Boar taint is a strong, faecal- and urine-like odour found in heat treated pork meat (Strathe et al. 2013). The main components responsible for boar taint are androstenone (5α-androst-16-en-3-one), skatole (3-methylindole) and indole (Drag et al., 2018). The threshold for androstenone and skatole detection is 0.5 - 1 µg/g and 0.02 – 0.25 µg/g, (Mörlein et al. 2012). The boar taint due to high levels of skatole can reduced by diet and keeping animals away from faecal contamination while taint due to androstenone can be completely removed by castration (Whittington et al., 2011).

In light of the current pressure to limit the use of physical castration in piglets without anaesthesia due to welfare issues, alternative methods are required for preventing or decreasing boar taint in pork from uncastrated male pigs. In particular, feeding dietary carbohydrates that are not hydrolysed within the small intestine but rather the hindgut (Øverland et al., 2011), such as fructans, reduces the amount of skatole produced by boars. Inulin-type fructans are carbohydrates that include all β (2←1) linear fructans. The supplementation of dried Jerusalem artichoke at 4.1, 8.2 and 12.2 % to finisher pigs reduced the prevalence of Clostridium perfringens within the colon and rectum, while decreasing the hindgut pH and faecal skatole concentrations after only seven days of supplementation (Vhile et al., 2012).

The contribution of the compounds varies widely on the procedures used to prepare the meat (Font-i-Furnols, 2012). Although pork is typically pan-fired or roasted, sous-vide cooking is growing in popularity. Furthermore, sous-vide foods compared to conventionally cooked foods will have an intense flavour as a result of the vacuum packaging, which prevents the development of oxidative off-flavours, and the loss of flavour volatiles (Peñaranda et al., 2017).

Thus, this study not only determined the effects of an extended Jerusalem artichoke supplementation period on the levels of boar taint compounds in boars, but also on the different cooking methods.

Materials and Methods

Animals and nutrition

All experimental procedures were approved by the Ethics Committee of the Central Commission for Animal Welfare at the Ministry of Agriculture of the Czech Republic (Prague, Czech Republic) and was carried out in accordance with Directive 2010/63/EU for animal experiments and Local Ethics Commission.

Twenty-four intact male pigs obtained from 10 litters produced by Czech Large White sire-line x (Czech Landrace dam-line x Czech Large White dam-line) pigs were used for experiment. All pigs were maintained in testing station, in an air-conditioned barn, essentially under the conditions according to Dvořáková et al. (2012). All pigs were fed *ad libitum* according to their standard nutrient requirements (Šimecek et al. 2000). The pigs were housed on slatted floors three per pen.

Animals were randomly assigned into 2 different dietary treatnemt groups (12animal per group) with 0% (C – control) and 8,2% (E – experimental) of driet jerusalem artichoke (*Helianthus tuberosus*) which were fed 14 days before slaughter. The pigs were slaughtered at a commercial abattoir following standard operational procedures at 154 days of age and average live live 108.6 kg.

Meat and fat samples

Samples of neck fat were analysed for androstenone and skatole content. Backfat samples in the neck region between cervical vertebrae 1 and 3 were taken 24 h after slaughter, vacuum packed, and frozen at – 80 ºC.

Muscle samples longissimus lumborum (LL) were taken for sensory analysis. The right LL muscle were trimmed of the epimysium, vacuum packing and placed into a refrigerator for 48 hours at 4 °C before being frozen at - 20 °C until analysis.

Sample preparation for sensory evaluation

The frozen samples were thawed for 24 hours at 4 °C prior to sensory evaluation and divided such that two cooking methods could be applied to each sample. Half of each sample was prepared by grilling on a double glass/ceramic plate grill (VCR 6l TL, Fiamma, Aveiro, Portugal) preheated to 200 °C, until an internal temperature of 75 °C was reached as measured by a digital temperature probe inserted into each sample (AD14TH, Ama-Digit, Kreuzwertheim, Germany). The remainder of the sample was vacuum-packaged (Vac-star, 180 × 200 mm, 90 µm thick), labelled and cooked in a water bath at 80 °C for 60 minutes. Immediately after cooking, samples were cut into 2 cm^3 cubes while excluding the outer meat surface, placed into glass containers and sealed. Each container/ sample was marked with a randomized three-digit code and placed into an oven at 50 °C for 1 hour until evaluation.

Selection of sensory panellists and descriptive sensory analysis

The sensory evaluation of pork meat was conducted in the sensory laboratory with individual booths. Six panellists were chosen from a total of 18, based on their ability to assess androstenone and skatole as described by Meier-Dinkel et al. (2013). The sensory analysis was carried out using a 10 cm unstructured line. Intensity of “pork meat odour”, “abnormal odour”, “pork meat flavour”, “abnormal flavour” attributes were rated from 0= “not perceivable” to 10= “extremely perceivable”. Twelve sets of two samples were presented to each panellist in each session, one sample being from boars fed Jerusalem artichoke and another from control boars both cooked using the same method within each set.

Determination of skatole, indole, and androstenone levels

Skatole and androstenone levels were determined in backfat samples using high-performance liquid chromatography (JASCO HPLC Series 2000) according to the method of Hansen-Møller (1994) as modified by Okrouhlá et al. (2016).

Statistical analyses

Data were analysed using a mixed linear model and parameters were estimated by the REML method of the MIXED procedure of the SAS statistical package. The model included fixed effect of dietary treatment, tissue sample, cooking method and random effect of assessor. The data in table are presented as least squares means (LSM) and standard errors of the mean (SEM).

Results and Discusion

Effect of feeding Jerusalem artichoke on androstenone, skatole and indole levels in backfat

Feeding Jerusalem artichoke decreased the levels of skatole in adipose tissue (table 1).

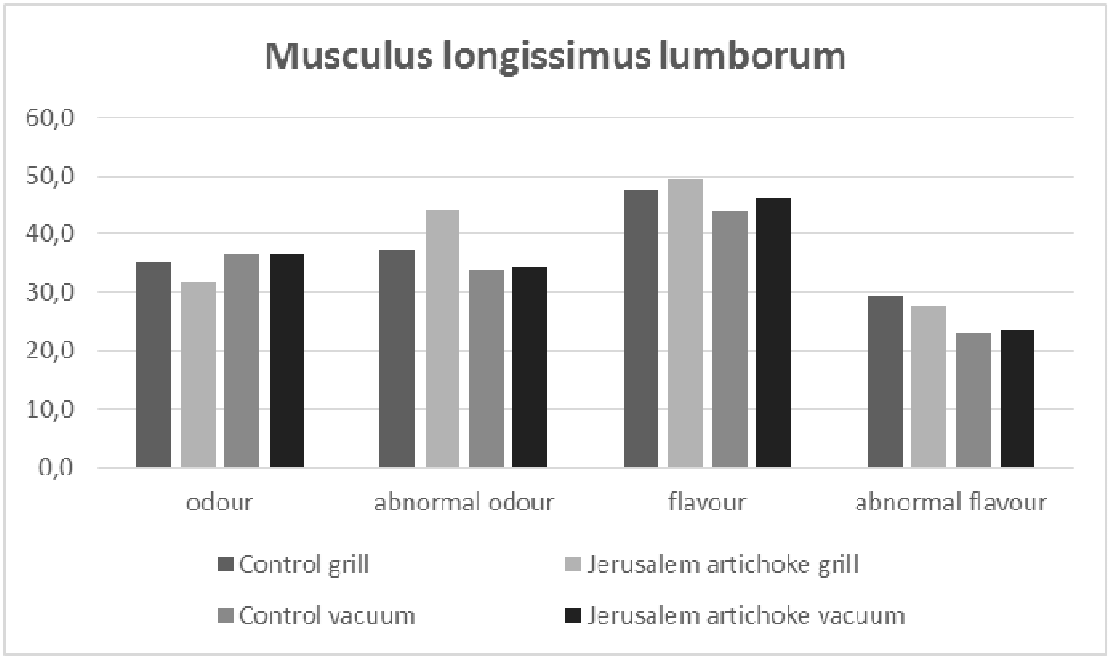
Significant differences (P=0.006) was observed between control and experimental group in back fat. In studies Aluwé et al (2017), Vhile et al (2012) and Kjos et al (2010) was described decreasing of skatole levels in backfat of entire male pigs due to the addition of Jerusalem artichoke. Carbohydrates that escape digestion in the small intestine serve as an energy substrate for bacteria in the large intestine. Thus, if sufficient amounts of fermentable carbohydrates are available, L-tryptophan will probably be incorporated into the bacteria to a large extent (Vhile et al. 2012). No statistically significant differences were observed in the levels of androstenone and indole. The level of androstenone is more influenced by the synthesis of steroid hormones in the testes and by the function of liver metabolism, rather than by changes in the digestive tract due to feed additives.

Sensory perception of meat samples

Fig. 1 presents the results for sensory characteristic of grilled and vacuum heating musculus longissimus lumborum of boars with different nutrition. The sensory scores differed between the two heating methods. Although grilled meat achieved a better typical pork flavour rating (49.5), vacuum cooked meat achieved overall lower and therefore better values for abnormal ratings (abnormal odour – 33.8 and abnormal flavour 23.7). The vacuum cooked meat has lost some of its aroma and flavour by treatment, so it has achieved worse results in typical pork odour and flavour. Also, according to studies by Bonneau et al. (2018) Font-i-Furnols et al. (2012) and Whittington et al. (2011) cooked meat is more sensory than roast. In the grill, sensory evaluation could be influenced by higher levels of sensory substances caused by heat treatment. Bekaert et al. (2013) suggest that if the temperature of the grill is too high or the sample is heated for too long, the boar taint could be masked by the odour of burnt fat.

Differences between control group and experimental group with Jerusalem artichoke in musculus longissimus lumborum are presented in fig. 2. Overall the effect of Jerusalm artichoke for loin has been demonstrated when evaluation the odour and abnormal odour for the grill. Differences in sensory perception of individual meat samples from control and experimental groups could be due to the presence of other components of boar taint (androstenone and indole). Although there was decreasing levels of skatol, other components of boar taint could have a negative effect on consumer perception. Peñaranda et al. (2017) describes that cooking on a grill or in a vacuum allows a higher perception of androstenone for consumers compared to frying or baking.

Fig. 1. Sensory characteristics of grilled and vacuum heating loin of entire male pig with different nutrition

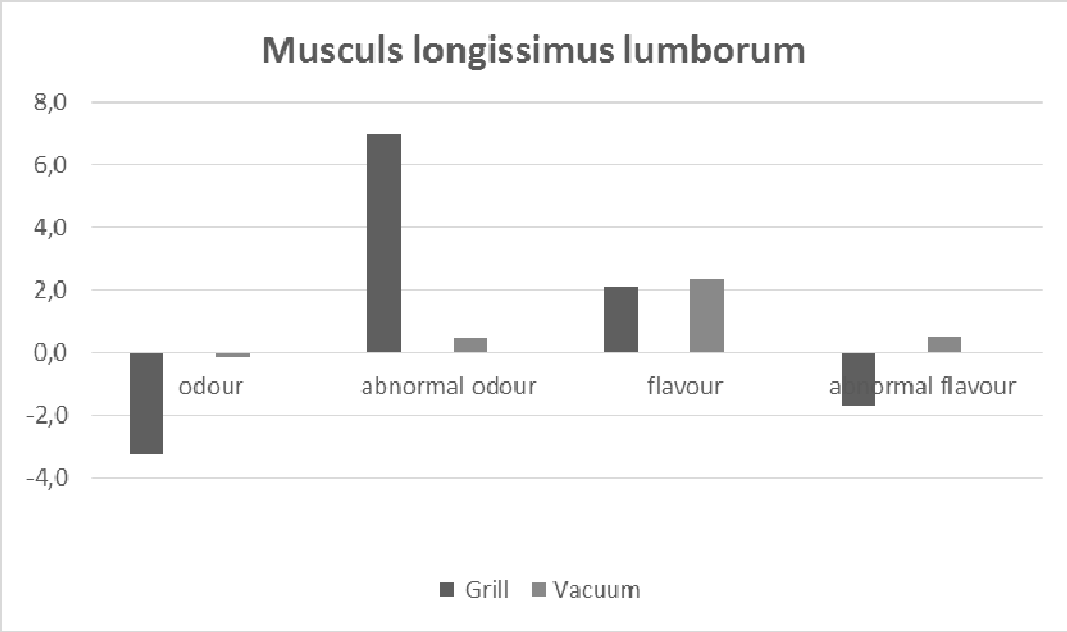


Tab. 1 Effect of feeding Jerusalem artichoke on levels of boar taint compounds in backfat

	Group			
Traits	Control LSM[1]	Experiment LSM[1]	RMSE[2]	*P*-value
Skatole backfat (µg/g)	0.046	0.025	0.003	□
Indole backfat (µg/g)	0.088	0.086	0.015	ns
Androstenone backfat (µg/g)	1.222	1.283	0.519	ns

* – significance between groups at P<0.05 ns – non significant

Fig. 2. Differences between control and jerusalem artichoke groups in musculus longissimus lumborum



Conclusion

Based on the obtained findings it could be said that the supplementation of boar feed rations with Jerusalem artichoke during the last 14 days before slaughter have a positive effect on decreasing skatole level in backfat. However, the addition of Jerusalem artichoke to the feed mixture did not significantly affect sensory perception. The heating method used has a strong influence on boar taint perception in meat from entire male pigs. Although the vacuum cooking method showed better olfactory characteristics grilled meat achieved a better typical pork odour and flavour rating it could be probably influenced by higher levels of sensory substances caused by heat treatment.

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