

# Consumption quality of cold smoked meat of male hybrids from Lithuanian indigenous wattle pig with wild boar intercross

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### Summary

The aim of the study was to compare the quality of salted cold smoked meat of 1/4 WB and 1/2 WB (wild boar) genotype hybrid entire and castrated males from Lithuanian indigenous wattle pig with wild boar intercross. There was no significant effect of the genotype on back fat thickness at the lumbar region, but entire boars had 7.3-11.1 mm smaller ( $P < 0.001$ ) lumbar back fat thickness at three points above *m. gluteus medius*. There were no statistically significant effects of genotype and gender on thawing loss and production yield of *m. semimembranosus* (SM). The panel study indicated no statistically significant effects of the genotype on cold smoked SM smell, tenderness, flavor and juiciness, but samples from 1/2 WB genotype had higher salinity ( $P < 0.001$ ). Samples of salted cold smoked from castrates had higher scores in smell and flavor ( $P < 0.01$ ) but lower in tenderness ( $P < 0.01$ ) and juiciness ( $P < 0.001$ ). A significant negative correlation was found between the age of entire boars and smell ( $P < 0.05$ ) and weight of animal and product salinity ( $P < 0.001$ ). The concentration of testosterone in plasma was negatively correlated with salinity ( $P < 0.001$ ). In the consumer panel study joints from castrated males had higher scores for smell ( $P < 0.001$ ) and flavor ( $P < 0.05$ ), but the lean/fat ratio ( $P < 0.001$ ) and the visual appearance ( $P < 0.05$ ) were judged to be poorer than those of entire boars. Consumers have found pork from hybrid entire boars to be acceptable.

**Keywords:** swine, Lithuanian indigenous, wild boar, smoked meat

Studies on the quality of wild boar meat have shown its advantage over pork (5, 8), and therefore introducing wild boar into the domestic pig genotype would be advantageous for food diversification. There is a growing interest in the production and marketing of wild boar meat and in various countries have set up farms specifically for wild boar production. The population of wild boar is limited and some meat may be derived from wild boar and domestic pig crosses.

The use of entire male pigs for pork production is limited because of the potential sensory defect, known as boar taint in meat from some males (2, 3, 5). In order to avoid boar taint in pork, many countries castrated most male piglets. In recent years there has been a growing concern over animal welfare issues related to castration (1). It has been recognized that the risks associated with castrating young male domestic pigs are minimal, but the surgical castration of wild boar is unacceptable, therefore, the castration of their hybrids with domestic pigs is been questioned.

Matthews et al. (9) have noted that in countries where a high proportion of pork is used as processed products, the reaction to boar taint is reduced because of applied processing procedures. In Lithuania the majority of pork meat is eaten in the form of traditionally salted and cold smoked

products (ham, shoulder, back fat). Therefore the aim of this study was to examine the eating quality of smoked meat of entire and castrated male obtained from the indigenous Lithuanian wattle race of pig intercrossed with wild animals.

### Material and methods

The study's experimental material consisted of 20 Lithuanian indigenous wattle pigs with wild boar intercross (1/2 WB genotype) and 19 backcross (Lithuanian indigenous wattle  $\times$  wild boar)  $\times$  : Lithuanian indigenous wattle (1/4 WB genotype male hybrids). The hybrids were born at the farm of the Institute of Animal Science of the Lithuanian Veterinary Academy. Fifteen males from both groups were castrated at the age of two weeks. The hybrids were reared indoors in mixed-gender groups from birth to slaughter. The animals were slaughtered at approximately 90 kg live weight, in the abattoir for controlled slaughtering of the State Pig Breeding Station after being transported for 5 km. Testes from entire boars were removed immediately after scalding and weighed. Measurements of back fat thickness were carried out with a ruler on the left half of chilled carcasses at the dorsal line: at the anterior part, above the highest point and at the posterior part of *m. gluteus medius*. Samples of *m. semimembranosus* (SM) were dissected (cut out) from the ham of the left half of the carcasses. All samples were stored for 5 days at  $-20^{\circ}\text{C}$ . Then, after

thawing at 15°C for 24 h, samples were injected using a multi-needle injector with 10% sodium chloride brine to a quantity of about 10% of the initial sample weight and then stored without tumbling for 24 h at 15°C (6), and cold smoked < 35°C for 3 days. The water holding capacity of SM was determined as thawing loss as weight difference of initial and defrosted SM (6). Processing yield was calculated as the yield difference between the initial weight and weight after smoking (7). Smoked samples were subjected to a taste panel and evaluated using subjective scoring scales from 1 = lowest intensity of the character to 9 = highest intensity, as described in the methodological guidelines (10). Samples were scored for pork smell, flavor, tenderness, juiciness as well as for salinity (6).

Blood samples of entire boars were taken from the vein *cava cranialis* at slaughter. Blood samples were collected in 10 ml tubes containing heparin. Samples were centrifuged for 5 min at 2000 rpm. Plasma samples were stored at -20°C until they were assayed for testosterone content. Testosterone (17 $\beta$ -hydroxyandrostenedione) concentration was determined by electrochemiluminescence immunoassay using Elecsys 1010 analyzer and appropriate reagents (Roche Diagnostics GmbH, Mannheim, Germany).

The taste panel comprised of 9 persons (five females and four males) who were selected on the basis of their ability to discern differences in organoleptic properties. A total of 5 panel sessions were convened with 3-5 samples being evaluated at each session. The average number of panelists attending each session was 8 with 7 being the minimum involved in any session. Samples were allocated from both groups in such a manner that each session contained a minimum of 1 sample from a castrated male and at least one and no more than 4 samples from entire males.

Consumer data were collected from the persons supplying the joints of hybrid carcasses using the method of personal interviews. The consumers were all regular meat-eaters. No instructions were given on meal preparation in order to assess pig meat quality according to the usual practice. A total of 20 families were involved in the study. The consumers were asked to evaluate the meat in

terms of: visual appearance (scoring scale: 1 = extremely unattractive, 9 = extremely attractive and lean/fat ratio (1 = too much fat, to 9 = very lean). The consumers also evaluated of the cooking smell (1 = extremely unpleasant, 9 = extremely pleasant) and flavor (1 = dislike extremely to 9 = extremely) and overall acceptability (1 = extremely unacceptable, to 9 = extremely acceptable).

Statistical analysis was performed with the General Linear Model (GLM) procedure in MINITAB release 14.20. The model included genotype (1/4 WB or 1/2 WB) and gender (entire boars or castrates) as fixed factors for the studied traits. Taste panel member and individual animal were included in the model as random factors. ANOVA and Tuckey's HSD significance test ( $\alpha = 5\%$ ) were used to ascertain the existence of significant differences between the traits. The effect of various factors (%) on the analyzed factors (genotype, gender, taste and animal) was studied by multi-way analysis of variance (ANOVA). Pearson's correlation coefficients were calculated.

## Results and discussion

The hybrids were slaughtered at a similar live weight, therefore, due to the slower growth of pigs from 1/2WB genotype, the age of 1/2WB genotype hybrids was higher ( $P < 0.001$ ) compared with 1/4WB genotype hybrids (tab. 1). 1/4WB genotype entire boars had higher, yet statistically insignificant, concentrations of testosterone. There was no significant effect of genotype on back fat thickness at the lumbar region, but entire boars indicated 7.3 (at the anterior part) – 11.1 mm (at the posterior part) of *m. gluteus medius* less than ( $P < 0.001$ ) lumbar back fat thickness. Interactions between different genotypes were observed for hybrid age ( $P < 0.001$ ) as well as genotype  $\times$  gender interactions for back fat thickness. There were no statistically significant effects of genotype and gender on thawing loss and processing yield of *m. semimembranosus*. Samples of

**Tab. 1 Taste panel evaluation by genotype and gender for eating quality scores of salted cold smoked *m. semimembranosus* and related parameters**

Characteristics	Genotype			Gender			Interactions			
	1/4 WB (n = 19)	1/2 WB (n = 20)	SED	Entire boars (n = 15)	Castrates (n = 24)	SED	1/4 WB genotype $\times$ gender	1/2 WB genotype $\times$ gender	1/4 WB entire boars $\times$ 1/2 WB entire boars	1/4 WB castrates $\times$ 1/2 WB castrates
Age, days	229.3	282.1	9.71***	249.3	256.4	13.29	ns	ns	***	***
Live weight, kg	88.1	90.5	1.02	89.5	89.1	1.12	ns	ns	ns	*
Back fat thickness at <i>m. gluteus medius</i> , mm:										
1	35.00	35.50	2.02	30.50	37.80	1.70***	ns	**	ns	ns
2	30.47	28.88	2.27	23.57	33.28	1.75***	**	**	ns	ns
3	35.64	34.35	2.60	27.93	39.08	1.98***	**	***	ns	ns
Thawing loss <sub>SM</sub> , %	5.7	7.1	2.28	6.5	6.7	1.27	ns	ns	ns	ns
Processing yield <sub>SM</sub> , %	73.3	75.0	2.28	74.4	74.1	2.30	ns	ns	ns	ns
Testosterone, mmol/l	134.2	103.7	50.25	113.9	-	-	-	-	ns	-
Tenderness	7.30	7.29	0.14	7.40	7.06	0.14*	ns	ns	ns	ns
Juiciness	7.29	7.41	0.14	7.55	7.02	0.14***	*	**	ns	ns
Flavor	7.25	7.20	0.19	7.03	7.59	0.19**	ns	ns	ns	ns
Smell	7.54	7.31	0.18	7.21	7.75	0.18**	ns	*	ns	ns
Salinity	2.75	4.34	0.31***	4.02	3.41	0.30	ns	ns	***	ns

Explanations: \* –  $P < 0.05$ ; \*\* –  $P < 0.01$ ; \*\*\* –  $P < 0.001$

wet salted, cold smoked SM from 1/4 WB and 1/2 WB genotypes were equally scored (tab. 1). There were no statistically significant effects of the genotype on pork smell, tenderness, flavor and juiciness. However, samples of SM from 1/2 WB genotype had higher salinity ( $P < 0.001$ ). Samples of salted, cold smoked SM from castrates showed higher scores for smell and flavor ( $P < 0.010$ ) but lower scores for tenderness ( $P < 0.010$ ) and juiciness ( $P < 0.001$ ). The salinity score tended to be higher ( $P = 0.057$ ) for SM from entire boars. This is consistent with the data of Banon et al. (3) who found that saltiness is less pronounced in ham from castrates. 1/4 WB genotype gender  $\times$  interaction ( $P < 0.05$ ) was only assessed for juiciness of SM. 1/2 WB genotype  $\times$  gender interactions was evaluated for smell ( $P < 0.05$ ) and juiciness ( $P < 0.01$ ). In all cases entire boars had higher scores. 1/4 WB entire boars  $\times$  1/2 WB entire boars interactions were for salinity with entire boars showing higher scores. No interaction between the castrates of different genotypes was found in relation to the sensory panel's evaluation of salted, cold smoked SM.

Differences in sensory evaluation of boar taint and genotype may be due to differing rates of sexual maturation. Pearson's correlation coefficients were additionally used for entire boars as an exploratory tool to ascertain significant associations of age, weight, weight of testes and concentrations of testosterone with any one sensory response. Correlation coefficients obtained for sensory attributes of salted, cold smoked SM were fairly low (tab. 2). Only the correlation coefficients for salinity were higher than those for other attributes. A significant negative correlation was found between the age of entire boars and smell ( $P < 0.05$ ) and weight of animal and muscle salinity ( $P < 0.001$ ). The concentration of testosterone in plasma was negatively correlated with salinity ( $P < 0.001$ ). Correlation between the age of entire boars and smell is in contrast with the finding of Squires et al. (11) who did not find significant correlations between sensory attributes and the levels of testosterone in the blood, but recently a significant correlation between testosterone and the boar taint compound androsterone has been found (2, 13).

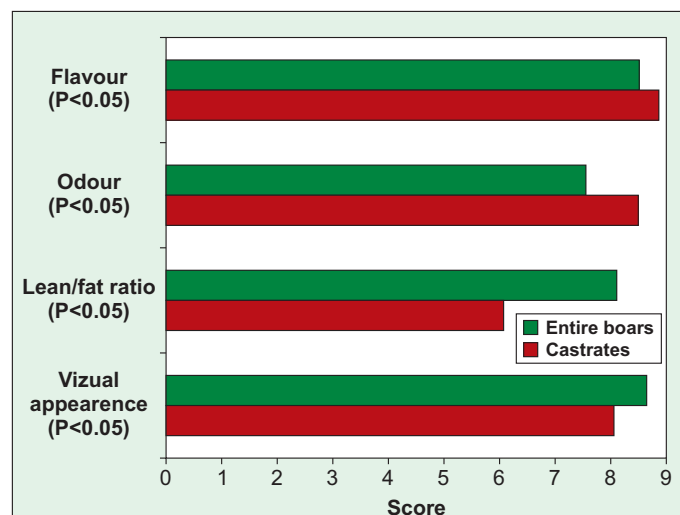
Variation analysis of sensory evaluation of smoked SM showed that the animals had the highest (from 12.2% to 84.5%) impact on the evaluation of pork sensory properties. The influence of gender on separate sensory properties was from 1.0% to 6.1% and the influence of genotype ranged from 0.0% to 12.7%.

Consumers in different countries have different attitudes to the taste of boar meat. Bonneau et al. (4), Matthews et al. (9), Weiler et al. (12) have reported on considerable variations between human populations with regard to the sensitivity of boar taint. Lithuanian consumers have no tradition of boar meat usage. The consumer panel results, in relation to the influence of gender on appearance, lean/fat ratio and eating quality of pork are presented in fig. 1. There was some evidence that joints from castrates had higher scores for pork smell ( $P < 0.001$ ) and flavor ( $P < 0.05$ ) but the lean/fat ratio ( $P < 0.001$ ) and visual appearance ( $P < 0.05$ ) were judged to be poorer than those for entire boars. Despite the fact that there was some evidence from the consumer study about the negative effects of entire boars on pork smell and flavor in comparison with the pork from castrates, all consumers have found the pork from entire boars acceptable.

**Tab. 2. Correlation coefficients between sensory scores of salted cold smoked *m. semimembranosus* and related parameters**

Characteristics	Age	Weight of animal	Testosterone	Weight of testes
Smell	-0.20*	-0.11	-0.20	0.04
Tenderness	-0.08	-0.05	-0.02	0.06
Flavor	-0.04	-0.14	-0.16	0.01
Juiciness	0.03	0.02	-0.06	0.05
Salinity	0.04	-0.35***	-0.679***	-0.14

Explanations: \* –  $P < 0.05$ ; \*\* –  $P < 0.001$



**Fig. 1. Consumer evaluation**

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