CA15215 Innovative approaches in pork production with entire mails

Meat quality

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Effect of surgical castration, immunocastration and chicory-diet on the meat quality and palatability of boars

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Table 3
Mean values of carcass and meat quality parameters of barrows (BA), boars vaccinated against GnRH (IMP), control boars (BO) and boars fed chicory (CBO).

	BA	IMP	BO
Carcass (n)	*90*	*98*	*52*
Carcass weight (kg)	93.6	92.9	90.1
Carcass lean meat (%)	57.7^{a}	60.6^{b}	60.3^{b}
Muscle thickness (mm)	62.4^{b}	62.5^{b}	60.4^{a}
Fat thickness (mm)	17.7^{b}	14.2^{a}	13.6^{a}
Meat quality (n)	*97*	*100*	*54*
$pH_{ultimate}$	5.6^{b}	5.6^{b}	5.4^{a}
L^*	57.3	56.3	57.2
a^*	8.5^{a}	8.9^{b}	8.8^{ab}
b^*	16.4^{ab}	16.4^{a}	16.8^{b}
Drip loss (%)	2.9^{a}	3.8^{b}	3.8^{b}
Cooking loss (%)	28.3^{a}	30.8^{c}	29.8^{b}
Shear force (N)	28.0	28.4	28.1
Boar taint (n)	*25*	*46*	*53*
Hot iron score	0.2^{a}	0.5^{a}	1.2^{b}

All meat quality parameters were affected by sex except for shear force (Table 3). Ultimate pH was lower for BO than for BA or IMP. Drip loss as well as cooking loss were lowest for BA compared to BO and IMP. Cooking loss was also higher for IMP compared to BO. This contradicts several other studies (D'Souza &Mullan, 2003; Gispert et al., 2010; Pauly et al., 2009; Skrlep et al., 2010; Zamaratskaia et al., 2008). Colour determinants were affected as well. BA and BO tended to have lighter meat (L*) than IMP.

Effect of surgical castration, immunocastration and chicory-diet on the meat quality and palatability of boars

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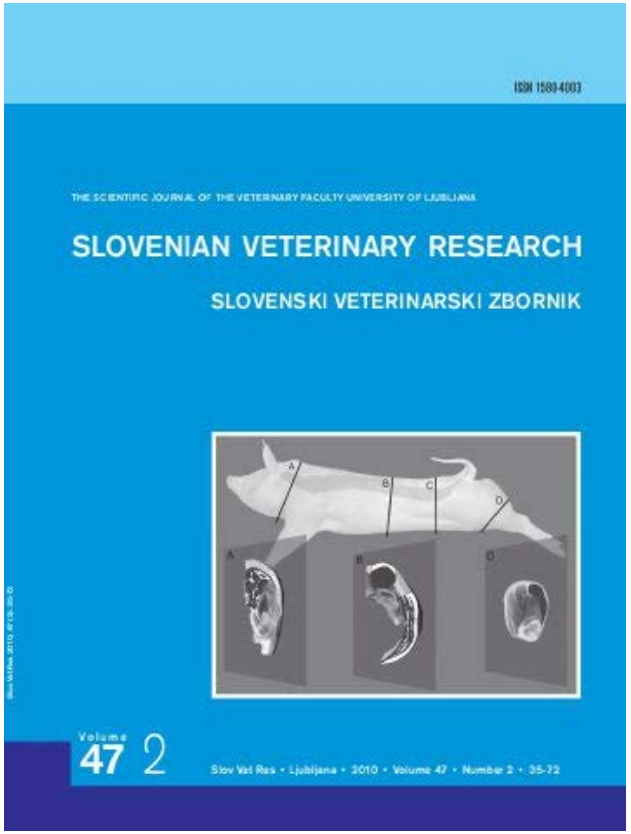
Table 5
Pearson correlation coefficients between the home consumer panel (cook) and the meat quality characteristics.

	Colour uncooked	Colour cooked	Cooking odour	Odour	Flavour	Juiciness	Tenderness	General
Hot iron	−0.01	−0.11	−0.02	−0.05	**−0.17***	−0.13	**−0.20***	**−0.18***
Indole	0.05	0.03	0.03	**−0.19T**	−0.11	−0.02	−0.10	−0.11
Carcass Weight	0.08	0.03	**0.10T**	0.06	0.07	0.04	0.08	0.08
Meat %	−0.03	0.02	0.03	0.02	−0.08	**−0.11T**	**−0.11T**	**−0.11T**
Fat thickness	0.05	−0.02	−0.01	−0.01	0.04	0.05	**0.10T**	**0.10T**
pH	**0.11T**	−0.04	−0.03	−0.04	0.03	**0.10T**	**0.10T**	**0.11***
L	**−0.17***	0.00	−0.02	−0.06	−0.03	−0.06	−0.01	−0.03
Drip loss	0.01	−0.02	−0.01	−0.03	−0.09	**−0.13***	**−0.13***	**−0.10T**
Shear force	0.08	**0.20***	0.09	0.06	0.04	0.01	−0.03	0.05

In contrast to the results of the meat quality measurements, no differences between BA, IMP and BO were found in colour before and after cooking, cooking odour, odour, flavour or general appreciation according to the results of the home consumer study (Table 4). The cooks found tenderness to be lowest for BO, intermediate for IMP and best for BA. For the general evaluation of the meat samples, BA tended to receive higher scores as compared to IMP and BO.



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Original Scientific Article

EFFECT OF IMMUNOCASTRATION (IMPROVAC®) IN FATTENING PIGS II: CARCASS TRAITS AND MEAT QUALITY

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Table 3: Meat quality traits (mean ± se) in surgical castrates, imunocastrates and boars

	SURGICALLY CASTRATED MALES	IMMUNO-CAS-TRATED MALES	BOARS	*P-value*
Number of carcasses	24	24	25	
Marbling BF (1-7)	3.4 ± 0.25[a]	2.9 ± 0.15[ab]	2.6 ± 0.17[b]	0.036
Marbling LD (1-7)	1.3 ± 0.08	1.3 ± 0.07	1.2 ± 0.07	0.649
LD intramuscular fat, mg/g	19.8 ± 0.76[a]	15.8 ± 0.83[b]	15.6 ± 0.90[b]	0.001
pH_{45}	6.17 ± 0.05	6.27 ± 0.06	6.27 ± 0.06	0.306
pH_{24}	5.60 ± 0.03	5.62 ± 0.04	5.67 ± 0.04	0.375
Colour (1-6)	3.42 ± 0.10	3.46 ± 0.10	3.50 ± 0.11	0.861
Minolta L*	48.9 ± 0.59	49.2 ± 0.75	48.6 ± 0.76	0.799
Minolta a*	7.3 ± 0.19	6.9 ± 0.22	6.9 ± 0.26	0.405
Minolta b*	2.8 ± 0.23[a]	2.1 ± 0.19[b]	2.4 ± 0.26[ab]	0.049
Drip 24h, %	2.8 ± 0.43	3.7 ± 0.52	2.7 ± 0.53	0.273
Drip 48h, %	4.5 ± 0.52	5.4 ± 0.61	4.2 ± 0.64	0.304

BF – muscle *biceps femoris*; LD – muscle *longissimus dorsi*; pH_{45} – pH measured in LD 45 minutes after slaughter; pH_{24} – pH measured in LD 24 hours after slaughter; Colour (1-6) denotes use of Japanese colour scale; means with different letters within one row are significantly different ($P<0.05$).

No significant differences between treatment groups were noted for pH value, colour or drip loss. Regarding intramuscular fat which is important for sensory quality, we noted a significant difference between surgical castrates and boars, whereas the immunocastrates were either intermediate (*biceps femoris* marbling) or closer to boars (*longissimus dorsi* intramuscular fat). The present study provided additional evidence of the benefits of the immunocastration for carcass quality, with no major effect on meat quality.

animal

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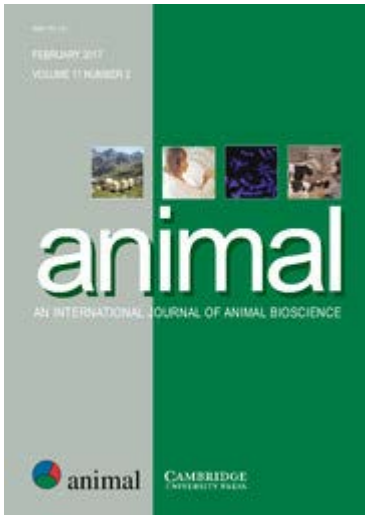

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Growth performance, carcass characteristics and meat quality of group-penned surgically castrated, immunocastrated (Improvac®) and entire male pigs and individually penned entire male pigs

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animal

Table 3 *Meat quality traits determined in the longissimus muscle from barrows (C), immunocastrated (IC) and entire male pigs (EMG) raised in group pens (experiment 1)*[†]

	Experimental group			
	C	IC	EMG	s.e.
Initial pH	6.20	6.22	6.28	0.495
Ultimate pH	5.50	5.49	5.49	0.167
L^*	50.1	51.0	50.3	0.34
a^*	6.5	6.1	6.5	0.21
b^*	2.8	2.7	2.7	0.18
Water holding capacity				
Drip loss (%)	4.06	4.22	4.56	0.394
Thawing loss (%)	11.19	12.09	12.52	0.619
Cooking loss (%)	15.80	15.61	16.84	0.540
Total purge loss (%)	25.18[d]	25.81[de]	27.25[e]	0.813
Shear force (kg)	3.70[a]	3.45[b]	3.77[a]	0.092

Initial and ultimate pH, L*, a*, b* values, as well as the percentages drip, thaw and cooking loss did not (P.0.05) differ among the experimental groups (Table 3). Shear force values were higher (P,0.01) in the longissimus muscle of C and EMG, compared to IC.

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Expected effects on carcass and pork quality when surgical castration is omitted — Results of a meta-analysis study ☆

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Table 2
Means of weighted differences between experimental treatments and significance of the related estimated effect size parameters β_{IC}, β_C, and β_F and effect size contrast for carcass characteristics and meat quality traits. In brackets the number of observations is given.[a]

Trait						*P*-effect				
	$D_{C\text{-}EM}$	$D_{IC\text{-}EM}$	$D_{F\text{-}EM}$	$D_{IC\text{-}C}$	$D_{IC\text{-}F}$	β_C	β_{IC}	β_F	$\beta_{IC\text{-}C}$	$\beta_{IC\text{-}F}$
Lean meat (%)	−3.00 (16)	−1.99 (4)	−0.62 (12)	0.79 (4)	−3.22 (1)	*	*	*	*	*
IMF in the LD (%)	0.55 (13)	0.40 (1)	0.15 (11)	−0.20 (1)	– (0)	*	*	*	ns	ns
Initial pH	0.00 (16)	−0.02 (2)	−0.02 (21)	−0.01 (2)	0.02 (1)	ns	ns	*	ns	ns
Ultimate pH	0.02 (23)	−0.01 (4)	0.01 (28)	−0.02 (4)	0.00 (1)	*	ns	*	*	ns
L*	0.57 (13)	1.09 (3)	−0.17 (14)	0.13 (3)	0.95 (1)	*	*	ns	ns	*
Drip loss (%)	−0.01 (13)	0.63 (3)	−0.15 (15)	0.56 (3)	0.62 (1)	ns	ns	ns	ns	*
Shear force (kg)	−0.17 (11)	−0.33 (1)	−0.49 (11)	−0.25 (1)	– (0)	*	*	*	*	*
SFA (%)	2.45 (4)	2.47 (2)	– (0)	−0.37 (2)	– (0)	*	*	–	ns	–
MUFA (%)	0.89 (4)	0.70 (2)	– (0)	−0.95 (2)	– (0)	*	ns	–	ns	–
PUFA (%)	−3.38 (4)	−3.18 (2)	– (0)	1.41 (2)	– (0)	*	*	–	ns	–
Sensory tenderness	0.00 (9)	0.63 (4)	0.04 (6)	0.03 (4)	0.55 (1)	ns	ns	ns	ns	ns
Sensory juiciness	0.06 (8)	0.35 (4)	−0.19 (6)	0.15 (4)	0.00 (1)	ns	ns	ns	ns	ns

[a] EM: entire males, IC: immunocastrates, C: castrates, F: females, D: arithmetic means of the differences; *P*: level of significance; *: $P<0.05$; ns: no significance ($P>0.05$).

Regarding pork quality traits only the difference in shear force between IC and EM was of relevant magnitude. This meta-analysis revealed that the implementation of EMproduction should not be hindered by pork quality concerns.

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Carcass and meat quality characteristics of immunocastrated male, surgically castrated male, entire male and female pigs

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Table 5
Least square means of the meat quality variables[A].

	CM	IM	FE	EM	*p*-value
pH45LT	6.29	6.27	6.25	6.26	0.85
pH45SM	6.34	6.33	6.32	6.36	0.87
pHuLT	5.49	5.47	5.47	5.49	0.25
pHuSM	5.47	5.47	5.47	5.49	0.39
ECuLT (mS)	4.49	4.69	4.51	4.35	0.75
ECuSM (mS)	7.10^{ab}	6.79^{ab}	8.09^{a}	6.03^{b}	0.023
L^*	48.62^{a}	48.84^{a}	47.89^{ab}	47.02^{b}	0.0045
a^*	5.76^{b}	6.39^{ab}	5.87^{b}	6.60^{a}	0.0050
b^*	1.38	1.61	1.25	1.33	0.24
COLOUREJC	2.83	2.78	2.90	2.91	0.43
Marbling NPPC	1.83^{a}	1.41^{ab}	1.38^{ab}	1.33^{b}	0.02
IMFSM (%)	2.47^{a}	2.07^{ab}	1.72^{b}	1.84^{b}	0.0028

ECu: ultimate electrical conductivity; EJC: Japanese Scale Colour; LT: *longissimus thoracis*; SM: *semimembranosus*. L^* : luminosity; a^* : redness; b^* : yellowness. NPPC: National Pork Production Council. IMF: intramuscular fat content.
CM: castrated males; IM: immunocastrated males. FE: females; and EM: entire males.
[A] For each variable means with different superscripts among columns are significantly different ($p < 0.05$).

Statistically **significant differences** ($p < 0.05$) were found in muscle SM **electrical conductivity** (ECuSM), **luminosity and redness** (L* and a*, respectively), as well as on **marbling**. There were **no significant effects** of animal type on **pH**,or **COLOUREJC**. However, for all meat quality variables studied, there were no significant differences between meat from IM and CM.

Table 5
Least square means of the meat quality variables[A].

	CM	IM	FE	EM	*p*-value
pH45LT	6.29	6.27	6.25	6.26	0.85
pH45SM	6.34	6.33	6.32	6.36	0.87
pHuLT	5.49	5.47	5.47	5.49	0.25
pHuSM	5.47	5.47	5.47	5.49	0.39
ECuLT (mS)	4.49	4.69	4.51	4.35	0.75
ECuSM (mS)	7.10^{ab}	6.79^{ab}	8.09^{a}	6.03^{b}	0.023
L^*	48.62^{a}	48.84^{a}	47.89^{ab}	47.02^{b}	0.0045
a^*	5.76^{b}	6.39^{ab}	5.87^{b}	6.60^{a}	0.0050
b^*	1.38	1.61	1.25	1.33	0.24
COLOUREJC	2.83	2.78	2.90	2.91	0.43
Marbling NPPC	1.83^{a}	1.41^{ab}	1.38^{ab}	1.33^{b}	0.02
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ECu: ultimate electrical conductivity; EJC: Japanese Scale Colour; LT: *longissimus thoracis*; SM: *semimembranosus*. L^*: luminosity; a^*: redness; b^*: yellowness. NPPC: National Pork Production Council. IMF: intramuscular fat content.
CM: castrated males; IM: immunocastrated males. FE: females; and EM: entire males.
[A] For each variable means with different superscripts among columns are significantly different ($p < 0.05$).

Although meat colour was lighter in CM and IM than in EM ($p < 0.05$), the lightness for those treatments was considered to be normal for loin meat i.e. neither too dark nor too pale, with **no evidence** of being either **PSE** (pale, soft, and exudative) or **DFD** (dark, firm, and dry). The differences, although significant, were not relevant because in all the cases the **colour was good**.

Original Paper

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Effect of immunocastration in group-housed commercial fattening pigs on reproductive organs, malodorous compounds, carcass and meat quality

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Table 3. Meat quality traits measured in *Longissimus dorsi* muscle (LSM) in entire males, immunocastrates, and surgical castrates

	EM $n = 19$	IC $n = 21$	SC $n = 20$	RMSE	*P*-value
IMF (%)	1.4^{a}	1.5^{a}	1.9^{b}	0.4	< 0.001
pH_{45}	6.27^{a}	6.31^{ab}	6.40^{b}	0.17	0.04
pH_{24}	5.42^{a}	5.52^{b}	5.44^{a}	0.08	< 0.001
Colour (1–6)	3.3^{a}	3.6^{b}	3.5^{ab}	0.4	0.04
L^*	54.2^{b}	50.6^{a}	53.5^{b}	2.8	< 0.001
a^*	7.8^{b}	6.8^{a}	7.1^{ab}	1.0	0.01
b^*	3.6^{b}	2.9^{a}	3.4^{ab}	0.7	0.01
Drip loss 24h (%)	5.3^{b}	2.9^{a}	3.6^{a}	1.9	0.001
Drip loss 48h (%)	8.5^{b}	5.5^{a}	6.4^{a}	2.1	< 0.001
Cooking loss (%)	28.4	28.6	26.6	4.4	0.29
Shear force (N)	139	144	136	23	0.54

EM = entire males, IC = immunocastrates, SC = surgical castrates, RMSE = root mean square error, IMF = intramuscular fat content, pH_{45} = muscle pH value 45 min after slaughter, pH_{24} = muscle pH value 24 h after slaughter, Colour = subjective LD muscle colour evaluated according to a 6-point Japanese colour scale

[a,b]LSM values within a row with different superscript letters are significantly different ($P < 0.05$)

IC were similar to EM and were less fat than SC (P < 0.01). IC had lower intramuscular fat than SC (P < 0.01) and higher average pH 24 than both EM and SC (P < 0.01), resulting in darker colour. IC also demonstrated lower drip loss than EM (P < 0.05).

Conclusion:

- There are not many studies dealing with the immunocastration effect on meat quality.
- They show for the most part the absence of any effect on pH24 *(Pauly et al., 2009; Gispert et al., 2010; Škrlep et al., 2010; Boler et al., 2011;Morales et al., 2011;)*
- The absence of any effect on drip loss or colour *(Pauly et al., 2009; Škrlep et al., 2010; Boler et al., 2011).*
- Some reports indicate IC to have darker meat than SC (Silveira et al., 2008), lighter than EM *(Gispert et al., 2010) or lower drip loss than SC (Miclat-Sonaco et al., 2008)*.
- Current research is inconclusive and often contradictory