



Continuous straw provision reduces prevalence of oesophago-gastric ulcer in pigs slaughtered at 170 kg (heavy pigs)



Guido Di Martino^{a,*}, Katia Capello^a, Annalisa Scollo^b, Flaviana Gottardo^b, Anna Lisa Stefani^a, Fabio Rampin^a, Eliana Schiavon^a, Stefano Marangon^a, Lebana Bonfanti^a

^a Istituto Zooprofilattico Sperimentale delle Venezie, Viale dell'Università 10, 35020 Legnaro, Padova, Italy

^b Department of Animal Medicine, Production and Health, University of Padova, 35020 Legnaro, Padova, Italy

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ABSTRACT

Adopting a $2 \times 2 \times 2$ factorial design, this study evaluated whether continuous straw provision by racks, tail docking and gender (barrows vs. females) have an effect on the prevalence of lung lesions and oesophago-gastric ulcer (OGU) visually scored at slaughter in 635 Italian heavy pigs (169 ± 4 kg). The lung lesions were very low (72% of pigs with score 0), and were not significantly different among the experimental groups. Overall, OGU was diagnosed in 47% of the pigs. The consumption of small amounts of straw (70 g/day/pig) represented a protective factor against the onset of OGU (OR: 0.27). Barrows were more likely than females to have OGU (OR: 1.52), while no significant differences between docked and undocked pigs were detected. Nevertheless, the presence of straw acted as a protective factor particularly in undocked pigs (OR: 0.16), suggesting that in this group the absence of rooting material may have a stronger effect on welfare.

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Short communication

EU Council Directive 2008/120/EC (EU Council, 2008) requires farmers to provide pigs with straw or alike rooting materials and prohibits routine tail docking for preventing tail biting later in life. Several studies have demonstrated that the provision of straw can reduce tail biting and aggressive behaviour (EFSA, 2007). Nevertheless, because most pig husbandry facilities have slatted floors, large amounts of straw would block the slurry-based manure systems (Zonderland et al., 2008). In pigs fattened up to 100 kg b.w. the provision of <100 g/day/pig of straw in racks has been shown to reduce the occurrence of aggressive behaviour (Fraser et al., 1991; Beattie et al., 2000) and tail biting (Zonderland et al., 2008), without negatively affecting production (Jordan et al., 2008). However, only little is known about the effects of offering straw and resign on tail docking on specialized productions for cured meat, where the animals live longer (over 36 weeks) and grow heavier (over 160 kg) than in the conventional systems. Prolonged fattening may increase stress, because of the agonistic behaviour related to sexual maturity (in females) and less space per kilo meat than in conventional systems. Chronic stress was demonstrated to be an immunosuppressive factor in several pig breeds (Sutherland et al., 2006), and some behavioural stress markers were found to be associated to the risk of acute ulcers in pigs slaughtered at

95 kg (Dybkjaer et al., 1994). For these reasons, the present study was addressed to evaluate the prevalence of lung lesions and oesophago-gastric ulcers (OGU) in pigs slaughtered at 170 kg, as indicators of possible stressful conditions that might have occurred during lifetime. A $2 \times 2 \times 2$ factorial design was adopted to test the effects of the availability of straw by racks (absence vs. presence), long tail presence (docked vs. undocked pigs), and gender (barrows vs. females) on such measures. Moreover, Scollo et al. (2013) analysed the behavioural and haematological data during fattening from the same experiment.

The study was performed on 672 commercial crossbred fattening pigs (336 barrows and 336 females) housed in 24 one-gender pens containing 28 pigs each. All pens consisted of an indoor area with a solid floor and an outdoor defaecation area with a slatted floor. Half of the animals ($n = 336$) had been tail-docked on the fifth day of life. Upon arrival at the fattening unit, the pigs were approximately 12 weeks of age (body weight 25 ± 3 kg), and the fattening lasted 30 weeks. They were manually fed twice a day with two equal liquid meals, and the amount of feed delivered per pen was recorded. In 12 pens, uncut (long) wheat straw was always available in a metal rack. A detailed description of animals, feed composition, housing and management is reported in Scollo et al. (2013).

The animals were transported to the abattoir on the same day in four lorries (each one with two floors in both the truck and the trailer) with water access. The animals were loaded directly from the pens and transported between about 0500 and 0700 h without any

* Corresponding author. Tel.: +39 049 8084254; fax: +39 049 8830539.

E-mail address: gdimartino@izsvenezie.it (G. Di Martino).

break. At the slaughterhouse, the pigs spent about one hour in the lairage area, where pen-groups within the same experimental group were mixed. The eight experimental groups were weighted (169 ± 4 kg) and the feed conversion efficiency (weight gain/dry fed * 100) was calculated. After slaughtering, the stomachs were scored for the presence of OGU according to the classification of Robertson et al. (2002) for the *pars oesophagea*: 0 = normal (pearly white); 1 = hyperkeratosis (yellow); 2 = mucosal erosions; and 3 = severe ulcer. The lungs were inspected as well, and scored according to the method of Ostanello et al. (2007), based on the percentage area affected by lesions in each lobe. The data were analysed by means of logistic regression analyses. Presence of straw, tail docking, and gender were considered as the main factors and their interactions were added into the models. Not significant interactions were removed using a backward elimination process. The animal was the experimental unit. Regarding OGU, we compared the absence of lesions (scores 0–1) to their presence (scores 2–3). Furthermore, a polytomous logistic regression was carried out considering three categories: 0 + 1, 2 and 3. The lung lesions were analysed comparing the absence of lesions (score 0) to their presence (score 1 or higher). The reference categories of the three main factors were: absence of straw, presence of tail, and female, and the results were expressed as odds ratios (OR) with 95% confidence intervals (CI). Differences were considered significant for $P < 0.05$. All of the statistical analyses were performed using the software SAS v. 9.1 (SAS Inst., Inc., Cary, NC).

The feed conversion efficiency of the eight experimental groups was $32.27 \pm 0.58\%$ (group without straw: $32.02 \pm 0.53\%$; group with straw: $32.52 \pm 0.58\%$). The average amount of straw removed from the rack was 70 g/day/pig. Overall, the mean lung score was very low; for 72% of pigs, the total score was 0. No significant effect on the total lung score was found for any of the three main factors. Prevalence of 1–4 gastric scores of slaughtered pigs, on the basis of presence of straw, presence of tail and gender are shown in Table 1. Overall, OGU was diagnosed in 47% of the pigs. The results of the logistic regression analysis (Table 2) showed that barrows were more likely to have OGU than females (OR: 1.52, 95% CI: 1.08–2.12, $P = 0.014$). Taking into account the significant interaction between tail and straw ($P = 0.007$), straw provision was found to have been associated with a lower occurrence of OGU, though such protective effect was more evident in undocked pigs (OR: 0.16, 95% CI: 0.09–0.28), compared to docked ones (OR: 0.41, 95% CI: 0.25–0.69). As regards the polytomous logistic regression, no differences ($P = 0.663$) were observed between barrows and females (OR: 0.91, 95% CI: 0.60–1.37) when comparing scores 2 with scores 0–1. The analysis revealed no significant interaction between tail and straw ($P = 0.102$); thus only two ORs could be calculated: 0.61 (95% CI: 0.41–0.93) for tail and 0.27 (95% CI: 0.17–0.41) for straw. Regarding score 3, a significant gender effect ($P < 0.001$) was observed: the probability of having a severe ulcer was higher for barrows than for females (OR: 2.49, 95% CI: 1.65–3.78). The significant interaction between tail and straw ($P = 0.007$) highlighted a protective effect of straw, which was more evident in undocked pigs (OR: 0.14, 95% CI: 0.07–0.29) compared to docked pigs (OR:

0.45, 95% CI: 0.26–0.79). The low lung scores confirmed our previous results about animals' good health status (Scollo et al., 2013) and were much lower than those reported by Ostanello et al. (2007) in 10,041 Italian heavy pigs (40.4% with score 0). Lung scoring can be useful for acquiring information on Porcine Enzootic Pneumonia, recognized as a multifactorial syndrome involving the interaction among pathogens, environment, and host factors (Meriardi et al., 2012). The overall feed conversion efficiency remained in compliance with the expected performance range for heavy pig production (Mordenti et al., 1995). Straw seemed to have no effects, probably because of the small amount consumed, confirming previous findings on pigs slaughtered with 90 kg (Day et al., 2002; Jordan et al., 2008).

OGU is a common finding in swine. It occurs more frequently than ulceration of the fundic region (Doster, 2000) and can result in mortality and reduced feed efficiency, with subsequent economic losses (Friendship, 2003). OGU has several predisposing factors: feeding practices, fineness of feed particles, feed nutrient content, infections and stress (Wondra et al., 1995; Amory et al., 2006). In our study, all of the pigs were subjected to the same conditions in terms of husbandry and slaughter, thus all of the differences are presumably attributable to the experimental treatments. The results showed that the presence of straw, though continuously provided in small amounts, may represent an important protective factor against the onset of OGU. The explanation may be related to the protective action of continuous chewing and ingestion of small amounts of fibres, which has already appeared to have a beneficial effect on the development of gastric lesions in 104 kg sex-mixed pigs housed in straw bedded housing systems compared to fully-slatted ones (Scott et al., 2007). The better health/welfare of the pigs that had been provided with straw was also confirmed by the higher frequency of exploring behaviour and the lower level of serum haptoglobin found in the same animals at the end of fattening (Scollo et al., 2013). The finding that females had lower scores for OGU may be attributed to the protective effect of estrogens, as demonstrated in female mice (Shimozawa et al., 2006). This gender difference has not been reported in fattening light pigs (Elbers et al., 1995; Robertson et al., 2002), probably because of the different physiology (i.e., hormonal production) in younger animals. The mean amount of straw removed was comparable to that reported for weaner and light pigs: 63 g/pig/day for Fraser et al. (1991); 92 g/pig/day for Day et al. (2002) and 100 g/pig/day for Jordan et al. (2008). Given that this was a small amount and the rack was set within the area with solid floor, there were no management problems due to slurry outflow obstruction. We were not able to maintain the pen-group as statistical unit: this aspect was incompatible with the routine slaughtering process, but may represent a limitation for this study. Our results revealed no significant differences between docked and undocked pigs in terms of OGU scores, although the provision of straw acted as a protective factor particularly in undocked pigs. This result is consistent with the data collected on farm from the same group of animals, which showed a higher risk of tail biting in comparison to docked pigs (Scollo et al., 2013). Both OGU and tail biting are expressions of

Table 1
Prevalence of gastric alterations (scores 0–3) in slaughtered heavy pigs (170 kg), on the basis of provision of straw, presence of undocked tail and gender.

Score	No straw		Straw		Docked		Undocked		Barrows		Females	
	n.	%	n.	%	n.	%	n.	%	n.	%	n.	%
0	12	3.85	92	28.48	37	11.53	67	21.34	46	14.47	58	18.30
1	103	33.01	128	39.63	118	36.76	113	35.99	107	33.65	124	39.12
2	95	30.45	49	15.17	85	26.48	59	18.79	61	19.18	83	26.18
3	102	32.69	54	16.72	81	25.23	75	23.89	104	32.70	52	16.40
Total	312	100	323	100	321	100	314	100	318	100	317	100

Table 2

Effects of continuous provision of straw on gastric alterations (scores 0–3) in docked/undocked barrows and female pigs (170 kg). The reference categories of the three main factors are absence of straw, presence of tail, and female. In case of straw x tail significant interaction, ORs are reported for straw factor stratified for tail presence and absence.

Type of comparison		STRAW	TAIL	SEX	STRAW x TAIL	
					Docked ^a	Undocked ^a
Scores 0 + 1 vs. 2 + 3	OR			1.52	0.41	0.16
	95%CI			1.08–2.12	0.25–0.69	0.09–0.28
Scores 0 + 1 vs. 2	OR	0.27	0.61	0.91		
	95%CI	0.17–0.41	0.41–0.93	0.60–1.37		
Scores 0 + 1 vs. 3	OR			2.49	0.45	0.14
	95%CI			1.65–3.78	0.26–0.79	0.07–0.29

^a Presence vs. Absence.

stress, which the presence of rooting material seemed effective to reduce. However, considering the complexity of tail biting (EFSA, 2007), further studies will be needed to confirm this result in different husbandry and environmental conditions.

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