Effect of different pre-slaughter procedures on behavioural and blood parameters in pigs

Pietro Calà[1], Francesco Tassone[1], Michele Comellini[2], Maria Cristina Ielo[2], Luisa Volpelli[2], Stefania Dall'Olio[1], Leonardo Nanni Costa[1]

[1]Dipartimento di Protezione e Valorizzazione Agroalimentare, Università di Bologna, Italy

[2]Dipartimento di Scienze Agrarie e degli Alimenti, Università di Modena-Reggio Emilia, Italy

Corresponding author: Leonardo Nanni Costa. DIPROVAL, sezione Allevamenti Zootecnici, Università di Bologna. Via F.lli Rosselli 107, 42100 Reggio Emilia, Italy - Tel. +39 0522 290515 - Fax: +39 0522 290523 - Email: leonardo.nannicosta@unibo.it

ABSTRACT - The effect of different pre-slaughter procedures on behavioural and blood parameters were evaluated on 120 pigs reared in one farm and delivered in groups of 40 subjects to three slaughterhouses. Due to the different attitude of the personnel involved, differences in handling were evident at loading and at unloading where the difficulties to drive the pigs increased the behavioural events. Blood analysis parameters showed that different resting time did not reduce the physical stress experienced by the pigs, which seems related *"per se"* to loading, transport and unloading and not to the different handling applied in each slaughter plant.

Key words: Pig, Pre-slaughter procedures, Behavioural events, Blood analyses.

Introduction - Impaired pig carcass and meat quality after slaughter are often attributed to differences in responses to pre-slaughter procedures related to the "farm of origin" effect, which accounts for genetic type, even in absence of stress susceptibility, feeding and housing condition. This generic attribution avoids a difficult assignment of responsibility for inadequate pre-slaughter handling, which usually flows from the slaughterhouse to the truck driver and finally reaches the farmer. In order to better define the role played by the pre-slaughter treatments on behavioural and metabolic responses with respect to the factor "farm of origin", the present study was carried out on a group of heavy pigs reared on one farm and slaughtered in three different plants.

Material and methods - Behavioural and blood parameters of 120 pigs (live weight kg 160±9) subjected to different pre-slaughter handling were examined. Pigs were delivered the same day in groups of 40 subjects from the same farm and slaughtered in three different plants, indicated as A, B and C. The castrated males and females in each group were 18 and 22, 19 and 21 and 17 and 23, respectively. During each delivery, the time of loading, transport, unloading, and resting were recorded (table 1).

Pigs were drove, using rubber pipes, by the truck driver and the farm personnel at the loading and by the truck driver and the plant's personnel at unloading. The transport was carried out by similar three decks vehicles, one for each group, where the space allowances ranged from 0.50 m^2 to 0.55 m^2 per 100 kg of live weight. At the end of the journey, each group was unloaded and droved to the resting pens where watering nipples were available. In all plants the unloading was carried out by a dock elevated to truck height. Mixing between subjects of different pens never occurred. During loading and unloading, the number of reversals, balks, falls, slips, bites, jumps, evacuations and vocalizations were recorded for each group. In the resting pens, one observation of 1min each 15min was carried out in order to record the postures (standing, sitting, lying down), exploratory, olfactory and aggressive actions as well as drinking, mastication and evacuation. According to the resting time, the number of observation was 5 at the plant A, 1 at the plant B and 4 at the plant C. In the slaughterhouse B the pigs were showered during resting with cold water for 6 minutes. The pigs

Table 1. Time (min) of pre-slaughter procedures in the three plants.

Plant	No. pigs	Loading	Trans-port	Unload-ing	Resting	Total
A	40	32	50	7	81	170
B	40	17	101	5	15	138
C	40	15	68	9	60	152

were electrical stunned by manual tongs in the A and C plants (V 180-220) and by automatic system (V 300) in the plant B. At sticking, the blood was collected from each pig and centrifuged at 3500 g for 15 min. The plasma samples were frozen at -20°C until analysis. Albumin, lactate, glucose, total protein, cortisol, urea, osmolarity and creatine kinase contents were determined by an automatic analyzer (BM HITACHI 911, Roche) and plasma cortisol by enzyme-immunoassay with the automatic analyser DPC Immulite (Medical System) and the COR LKCO1 kit (Medical System). The frequencies of behavioural events and postures were compared by χ^2 (Fischer's exact test). Values of creatine kinase, cortisol, lactate and osmolarity were normalised by a $\log_{10}$ transformation and glucose by inverse transformation. Data of plasma parameters were processed by the GLM procedure of SAS (1996). The model included the fixed effects of slaughterhouse, sex and their interaction, which was excluded from the model when not significant ($P<0.05$).

Results and conclusions - A significant difference ($P<0.05$) in the frequency of behavioural events between pigs addressed to plants A and C was found (table 2). At loading, a progressive raise of events was observed accordingly with the reduction of the driving time . They increased from 12 for the pigs destined to the plant A to 62 for those addressed to the plant C. The increase of behavioural events regarded mainly reversals and vocalizations. The difficulties to move the pigs towards the vehicle increased the use of the rubber pipe that, in turn, leads to more vocalizations. The observations recorded at loading highlight that differences in pre-slaughter handling raises very soon and confirms that fast driving increases the difficult to handle the pigs (Grandin, 2007).

Table 2. Behavioural events observed at loading and at unloading in the three plants.

Events	A				B				C			
	Loading		Unloading		Loading		Unloading		Loading		Unloading	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Reversal	4	33.3	1	100	9	21.9	2	9.1	21	33.9	7	25.9
Balk	3	25.0	-	-	16	39.0	2	9.1	20	32.2	-	-
Fall	1	8.4	-	-	1	2.5	2	9.1	1	1.6	2	7.4
Slip	4	33.3	-	-	5	12.2	6	27.3	5	8.1	-	-
Vocaliz.	-	-	-	-	10	24.4	10	45.4	15	24.2	18	66.7
Total	12	100.0	1	100.0	41	100.0	22	100.0	62	100.0	27	100.0
No.pipe/pig	1.6		0.2		4.1		0.7		4.8		4.8	

Despite very similar facilities and duration of unloading, there were significant differences ($P<0.01$) between the plants B and C in the frequency of the behavioural events. The higher number of events recorded in the latter plant, particularly the vocalization, could be related to a greater stimulation of movement, as showed by the higher use of the rubber pipe. In general, these results show that at loading and at unloading the differences in behaviour mainly reflected different personnel attitude to carry out such operations. The results of the behavioural observation during lairage are reported in table 3. The frequency of the postures in the first observation was similar in all slaughter plants, even if there is a significant difference ($P<0.05$) between B and C plants,

Table 3. Frequency of postures assumed during the resting time at the different observations (Obs).

	Obs. plant A			Obs. plant B	Obs. plant C		
Posture:	1st	2nd	3rd, 4th, 5th	1st	1st	2nd	3rd, 4th
Standing (%)	82.5	15.0	--	80.0	70.0	27.5	--
Sitting (%)	2.5	20.0	--	--	17.5	22.5	--
Lying down (%)	15.0	65.0	100.0	20.0	12.5	50.0	100.0

Table 4. Effect of slaughterhouse on plasma variables (untransformed least squared means ±SE).

		Plant A	Plant B	Plant C
Albumin	g/l	42.90^{b} ± 0.54	39.93^{a} ± 0.54	45.33^{c} ± 0.54
Lactate	mmol/l	16.08^{a} ± 0.72	9.47^{b} ± 0.71	12.19^{c} ± 0.73
Glucose	mmol/l	6.22^{ab} ± 0.23	7.00^{b} ± 0.23	5.46^{a} ± 0.24
Total protein	g/l	79.51^{b} ± 0.76	69.50^{a} ± 0.76	76.70^{c} ± 0.79
Cortisol	nmol/l	231.29 ± 0.03	201.89 ± 0.03	233.70 ± 0.03
Urea	mmol/l	5.34 ± 0.16	5.26 ± 0.16	5.29 ± 0.17
Osmolarity	mOsm/K	309.18^{b} ± 1.19	300.48^{a} ± 1.17	310.35^{b} ± 1.22
Creatin kinase	U/l	1536.85 ± 140	1610.53 ± 138	1525.97 ± 144

a, b, c=P<0.05.

the latter characterized by more sitting pigs. The behavioural events observed in the active subjects were limited to the exploration only (data not showed). At the second observation, the frequencies of posture were not statistically different (P>0.05) between A and C plants, while, to respect to the previous one, an increase of subjects lied down was observed in both plants.

Moreover, all the active subjects manifested exploratory activities only, confirming what was recorded in the first one. The subsequent observations found all pigs lied down until the stunning. least squares mean values of plasma variables are shown in table 4. They were within the normal range (Boyd, 1984) in all groups excepted for the higher lactate and CK values. The levels of albumine, osmolality and total protein were higher (P<0.05) in the plasma of pigs slaughtered in plants A and C with respect to those slaughtered in plant B. This might indicate a week dehydration (Knowles and Warriss, 2007) in the former pigs, probably related to the longer resting time and to the absence of stimuli to drink, as the behavioural observation shown. In addition, the lower glucose and the higher lactate levels observed in pigs slaughtered in A and C plants (P<0.05) could be due to the longer lairage, even if their physical activity was limited to the exploration. Creatine kinase activity was found very high in all groups of pigs. Irrespectively of the differences in pre-slaughter procedures, the means values did not differ significantly among the groups. This result suggests that in terms of reaction to the physical stress experienced before lairage, the examined pigs showed a similar response. The prolonged resting time in A and C plants was not sufficient to recover from this stress. A significant interaction (P<0.05) between slaughterhouse and sex was found for the cortisol. The females showed the highest values in plant A and B and the lowest in plant C. In general, the results achieved show that, irrespectively of the common origin of examined pigs, differences in pre-slaughter handling and, consequently, differences in pre-slaughter behaviour raise very soon, mainly related to the attitude to the personnel in animal driving. The most evident consequences concern the behaviour of animals and the metabolic responses to the resting, while the physical stress related to the pre-slaughter handling seems less affected by different pre-slaughter procedures.

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