PLASMA ADRENALINE LEVELS OF PIGS AFTER DIFFERENT PRE-SLAUGHTER HANDLING AND STUNNING METHODS

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INTRODUCTION

Driving of pigs to the stunning point and the stunning procedure itself cause physiological and psychological stress for the animals. Stress is known to be a factor that produces meat quality faults. During stress, blood-stream adrenaline increases. By activating enzyme systems, eventually phosphorylase, adrenaline causes an increased breakdown of glycogen to lactate, which accelerates the post-mortem pH drop in the musculature (HAID et al., 1973). The evaluation of different pre- slaughter handling and stunning methods in relation to the part they play in producing meat quality faults by measuring the resulting meat quality (pH, conductivity) is difficult. Some other incalculable exogenous and endogeneous (genetic) factors can overshadow the influence of the procedure to be tested. Therefore, the suitability of stress-induced plasma-adrenaline for evaluating the stress intensity, caused by different pre-slaughter handling and stunning methods, was investigated. The plasma adrenaline level seems to be suitable, because experiments on man have shown, that the amount of catecholamines released into the blood stream correlates positively with the degree of stress (WEICKER et. al., 1984; LITTLE et al., 1985) and catecholamines are not significantly different in stress-sensitive and stress-resistent pigs (ALTHEN et al., 1977).

MATERIALS AND METHODS

For analysing adrenaline levels after different pre-slaughter handling, blood was taken from an ear vein (2 ml EDTA-test-tube) immediately after driving. The following methods of driving pigs to the stunning point were examined:

1. Carefully driving in groups, along a wide corridor (length: 20 m, width: 1,40 m) n = 15.
2. Forced driving in groups along the same corridor (n = 8).
3. Driving as for 2. with additional isolation from the group, in the way HOENDERKEN (1976) proposed, supsequent forced driving (electric prods) along a single path runway (length: 15 m, width: 0,30 m), n = 13.
4. As for 3., but also including passage through a V conveyor restrainer (n = 25).

After different stunning methods (Tab. 1) blood samples were taken from the sticking point at precisely defined times (2-3 sec after sticking).

Tab. 1: Stunning methods

	Electrical stunning			CO_2-stunning
	manual (2-hand-tongs)		automatic (restrainer)	
Equipment	type: 66/1 82/283 Fa. Schermer, Ettlingen		type L 700 Fa. Banss, Biedenkopf	stunning box, CO_2-measuring instrument ULTRAMAT 21 P, Fa. Siemens
Voltage/ CO_2-concentration	180	250	600	60 - 85 %
Stunning time (sec)	10		1,7	180 - 90

The samples were centrifuged (Biofuge A, Heraeus-Christ GmbH, Osterode, W.-Germany) in 2 ml EDTA-tubes for 10 min with 8000 U/min, to remove red blood cells. The plasma was subsequently prepared immediately or frozen to -75°C for later examination. The adrenaline analyses were carried out with HPLC and an electrochemical detector (Millipore Waters Chromatographie) in accordance with the methods of Recipe Pharma Vertriebs GmbH, Munich.

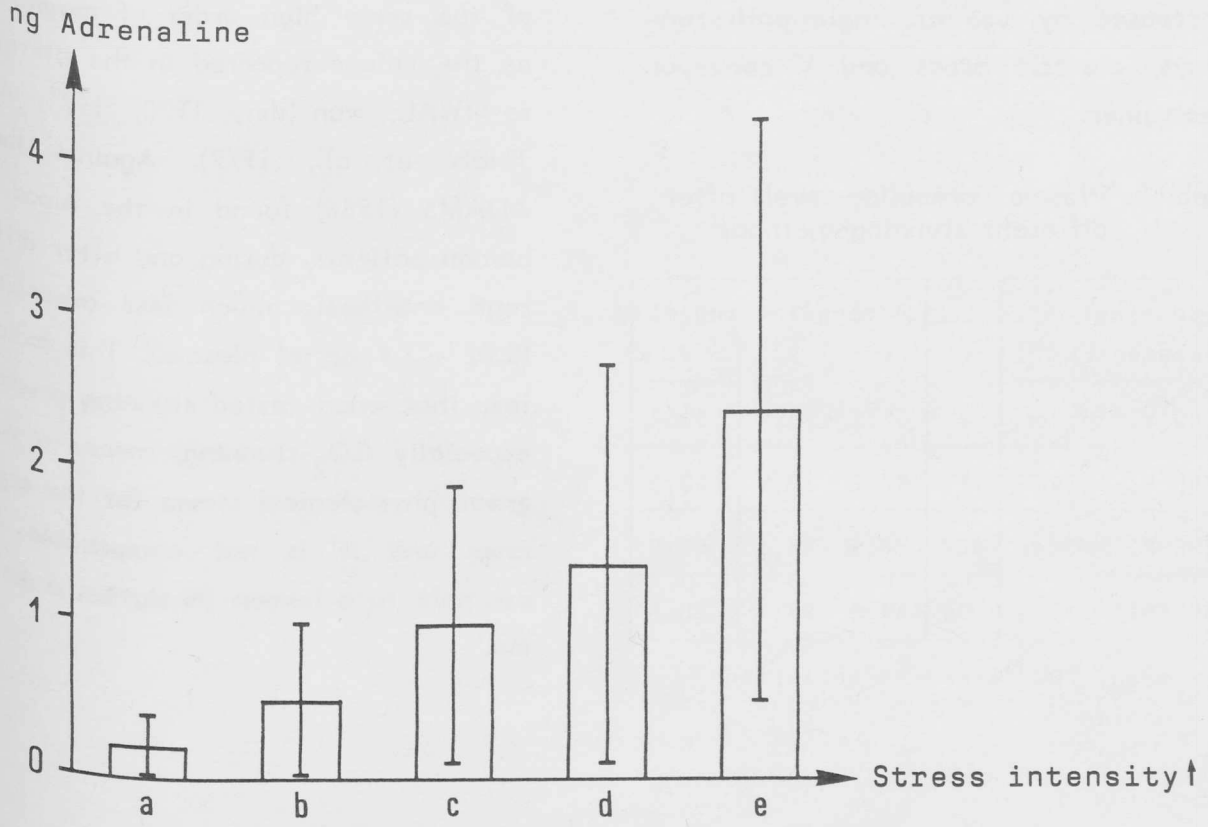
RESULTS

The adrenaline resting value is on average 0,2 ng/ml plasma (TROEGER u. WOLTERSDORF, 1989). After different pre-slaughter handling methods, the adrenaline values were evidently different (Fig.1).

Carefully driving (b) led to an adrenaline level of 0,5 ng/ml, after forced driving (c) the adrenaline value was 1,0 ng/ml plasma. When the pigs had passed through a single path runway, the plasma adrenaline level was on the average 1,4 ng/ml (d) and the passage through a V conveyor restrainer increased adrenaline additionally to 2,4 ng/ml plasma (e) that is, 12 times the resting value.

With all stunning methods there was a sudden rise in plasma adrenaline concentration. Tab. 2 shows means, standard deviations and medians after different electrical stunning methods and after CO_2-stunning. After the use of 180 V, 250 V and 600 V stunning voltage, the adrenaline values were on the average 55,8 ng, 60,7 ng and 70,6 ng/ml plasma respectively. The highest plasma adrenaline concentrations, 84,9

Fig. 1: Plasma adrenaline levels (ng/ml) of rested pigs and after different driving stress (mean $\bar{x}$, standard deviation s)



a: Resting-value
b: Carefully driving in groups
c: Forced driving in groups
d: Single path runway (electric prods)
e: Single path runway + V conveyor restrainer (electric prods)

ng/ml on average, were found after CO_2-stunning. The Figures 2, 3 and 4 show the frequency curves of adrenaline values after different electrical stunning methods. With higher stunning voltages higher adrenaline values were more frequent.

CONCLUSIONS

There is an evident connection between the subjectively notable stress induced by different pre-slaughter handling methods and the analysed adrenaline concentrations. Pre-slaughter handling stress is the sum of physiological and psychological stress. Great physiological stress is produced by rough driving of pigs along long single path runways, which the animals often pass very quickly because of a panic flight reaction. Psychological stress is produced by all situations, which frighten the animals such as isolation from the group or transport through a V convey-

or restrainer. Thus, both physiological and psychological stress is especially increased by use of single path runways, electric prods and V conveyor restrainer.

Tab. 2: Plasma adrenaline levels after different stunning methods

Stunning parameters	n	Adrenaline (ng/ml) $\bar{x}$	SD	$\tilde{x}$
180 V, 10 sec	92	55,8	25,8	51,7
250 V, 10 sec	114	60,7	29,5	53,5
600 V, 1,7 sec	104	70,6	36,1	61,8
60-85 % CO_2	38	84,9	28,7	80,6

$\bar{x}$ = mean, SD = standard deviation
$\tilde{x}$ = median

The adrenaline concentrations we found in the blood after stunning are of the same high order of magnitude as the values reported in the literature (WAL, van der, 1970, 1971; ALTHEN et al., 1977). Against that, ADAMS (1986) found in the blood of human patients, during and after different anästhesia much less adrenaline (0,02 - 3,9 ng/ml plasma). This indicates, that each tested stunning process, especially CO_2-stunning, means a very great physiological stress for the organism and it is not comparable for example to a human inhalation anästhesia.

Fig. 2: Frequency curve of plasma adrenaline after electrical stunning

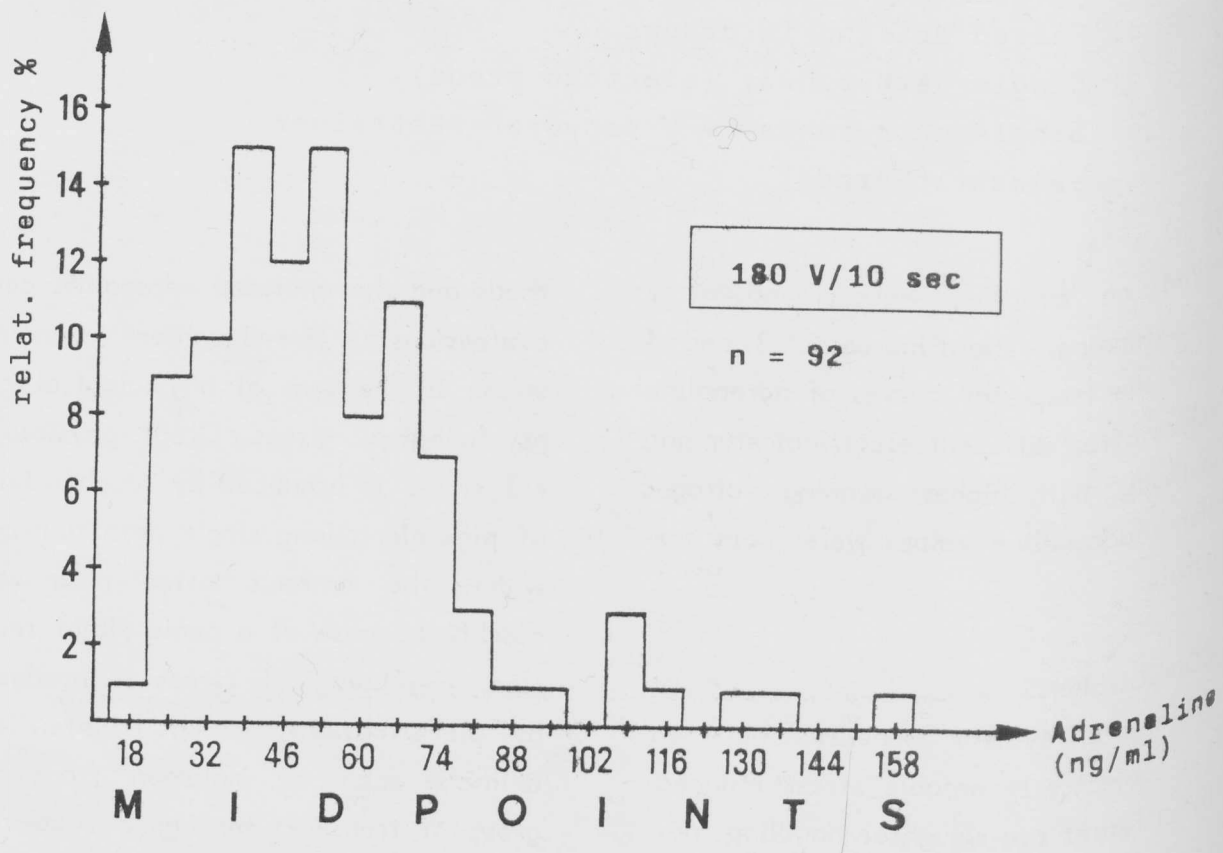


Fig. 3: Frequency curve of plasma adrenaline after electrical stunning

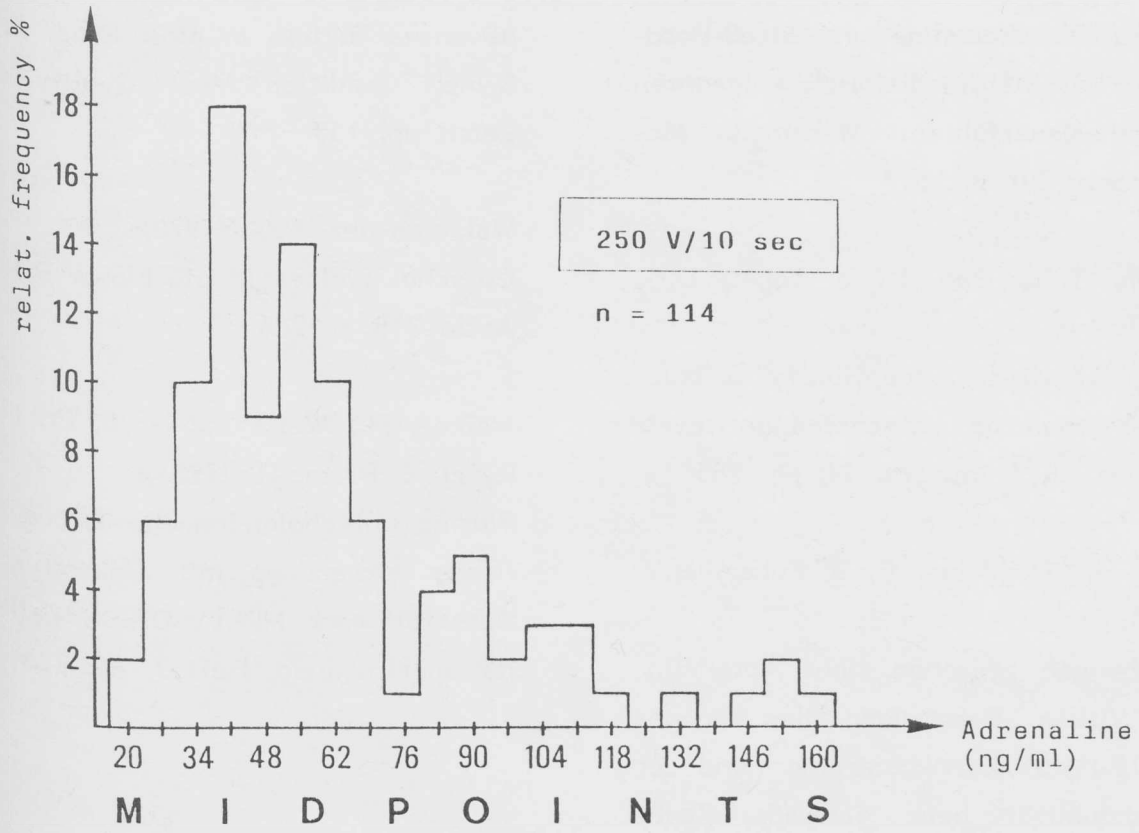
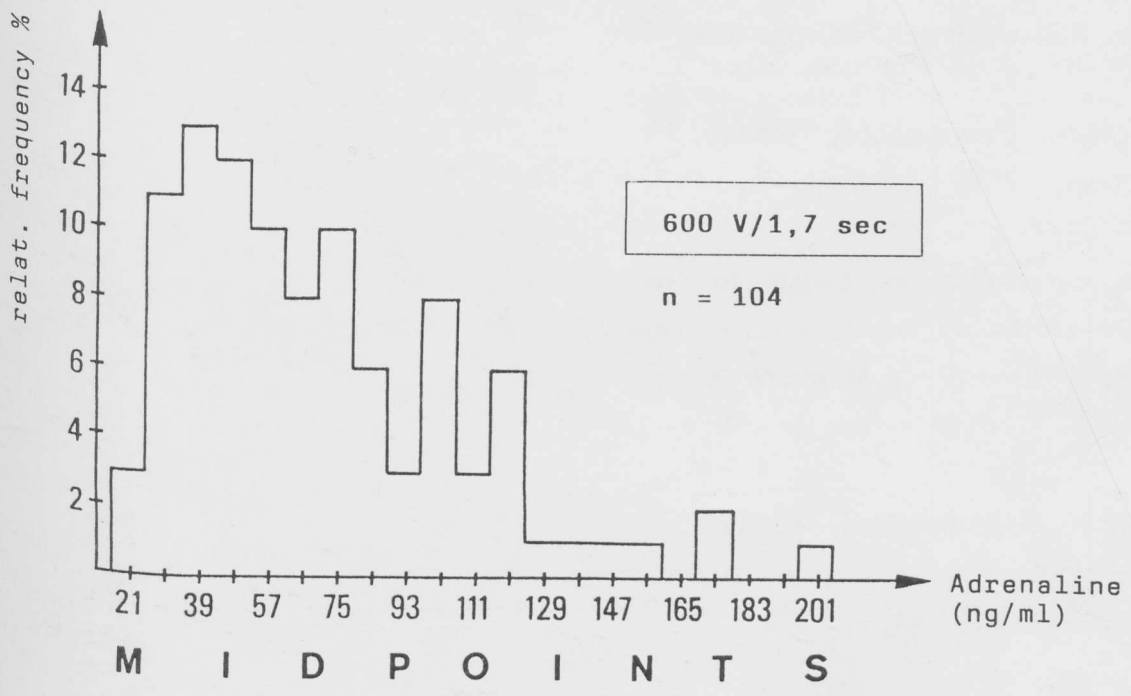


Fig. 4: Frequency curve of plasma adrenaline after electrical stunning



REFERENCES

Adams, H.A. (1986):
Plasma-Katecholamine und Streß-Parameter bei wehrmedizinisch relevanten Anaesthesieverfahren. Wehrmed. Monatsschrift **30**, pp. 517

Althen, T.G., Ono, K. & Topel, D.G. (1977):
Effect of stress susceptibility or stunning method on catecholamine levels in swine. J. Anim. Sci. **44**, pp. 985

Haid, H., Rogdakis, E. & Faber, H.V. (1973):
Beziehungen zwischen einer Adrenalin- bzw. Visken^{R}-Behandlung, den endogenen 11-Hydroxkortikosteroiden und der Fleischqualität beim Schwein. Züchtungskunde **45**, pp. 421.

Hoenderken, R. (1976):
Ein verbessertes System für das Treiben von Schlachtschweinen zum Restrainer. Fleischwirtsch. **56**, pp. 838

Little, R.A., Frayn, K.N., Randall, P. E., Stoner, H.B. & Maycock, P.F. (1985):
Plasma catecholamine concentrations in acute states of stress and trauma. Archives of Emergency Medicine **2**, pp. 46

Troeger, K. & Woltersdorf, W. (1989):
Measuring stress in pigs during slaughter. Fleischwirtsch. **69**, pp. 373

Wal, van der, P.G. (1971):
Stunning, sticking and exsanguination as stress factors in pigs. Proc. 2. Int. Symp. Condition Meat Quality Pigs, Zeist, pp. 153

Wal, van der, P.G. (1970):
Catechol amines in pig blood. Pflügers Arch. **318**, p. 286

Weiker, H., Weiss M., Hack, F., Hägele, H. & Pluto, R. (1984):
Plasma-Katecholaminnachweis und praktische Anwendung mit elektronischem Detektor nach HPLC. Dtsch. Zeitschr. für Sportmedizin, Heft 7, pp. 225