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SOME OBSERVATIONS ON BLOOD COMPOSITION AND MEAT QUALITY IN RELATION TO THE ANTE MORTEM HISTORY OF HOGS

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I. Influence of stress on meat quality caused by the use of a restraining corridor

INTRODUCTION

Measurements of pulse rate (1) have indicated substantial stress in hogs driven through a restraining corridor preceding the CO₂ immobilizer.

This observation was consistent with a rise in the level of corticosteroids and glucose in the bloodplasma.

During the summer of 1969 we tried to ascertain whether or not this stress led to an increased risk of defects in meat quality.

Furthermore we looked for parameters from the live animal which could help us to explain differences in meat quality.

MATERIALS AND METHODS

Twenty four hogs of known parentage (Dutch Landrace) were divided into two groups. Both groups were given 3 hours rest before slaughtering.

The first group was then driven quietly through an alley 1.5 m. wide towards a man handling electric tongs, were immobilized there and bled.

The hogs of the second group were driven through the restraining corridor and were also immobilized with electric tongs and bled in the same way.

Blood samples were taken for the determination of corticosteroids and glucose in the plasma.

Twenty four hours slaughtering, pH measurements were taken in the following muscles:

- M.subscapularis (shoulder)
- M.semitendinosus (ham) and
- M.adductor (ham)

Hams and shoulders were cured and canned according to our standard laboratory procedure.

The cooking losses were estimated and the products were tested organoleptically.

RESULTS

The quality test on the hams and shoulders (colour, taste, firmness, etc.) revealed no significant differences between the products manufactured from the hogs driven through the corridor and those from the control group.

TABLE 1
FREQUENCY DISTRIBUTION OF SOME OF THE PARAMETERS

		Corticosteroids /ug/ 1							
		30	30-39	40-49	50-59	60-69	70-79	80-89	89
With restraining corridor		4	3	3					2
Without restraining corridor		8	2	1		1			
		Glucose mg/100 ml							
		90-109	110-129	130-149	150-169	170-189	190-209	120-229	229
With restraining corridor		1	2	4		3			2
Without restraining corridor		2	3	2	2	1		1	1
		pH 24 hrs							
		5.6	5.7	5.8	5.9	6.0	6.1	6.2	6.2
With restraining corridor		1			1	4	2	1	1
Without restraining corridor		1		3	3	1		1	
		Cooking loss %							
		6	6	7	8	9	10	11	
With restraining corridor									
Without restraining corridor		1		4	4	3			
				3	3	4	1	1	

each hog are given.

For pH 24 hrs the average values found in the 3 muscles of

Results of 3 pH-measurements were accidentally lost.

For cooking losses in this table the weighted averages of the losses found for the hams and shoulders of every hog are used.

TABLE 2
AVERAGE VALUES OF THE PARAMETERS AND
THEIR STANDARD DEVIATIONS

	With corridor		Control group	
	Average	st.dev.	Average	st.dev.
Corticosteroids ug/l	13.53	8.36	9.86	3.75
Glucose mg/100ml	156.91	47.1	147.3	53.7
Rigor shoulder [†]	12.3	3.9	12.7	3.0
Rigor ham	12.0	1.3	11.4	1.24
pH 24 hrs shoulder	6.28	0.23	6.17	0.28
ham semidendinosus	5.60	0.35	5.50	0.11
ham adductor	5.98	0.39	5.85	0.16
Cooking loss shoulders %	5.92	0.82	6.50	1.24
ham right %	6.17	1.53	5.83	1.11
ham left %	6.10	0.58	5.79	0.78

[†] Sybesma-units

Only the difference between the values of the cooking loss of the "ham right" reached singnificancy. ($P \leq 0.005$)

DISCUSSION

Although the differences are not statistically significant bloodplasma corticosteroids and glucose levels in the animals driven through the corridor are higher than those in the animals in the control group.

This agrees with the results of our earlier experiments.

However, the differences in organoleptic meat quality parameters between the two groups, were far from significant.

This indicates that under our experimental conditions the fact that the hogs endure a substantial stress in the restraining corridor did not lower the meat quality.

- II. Moderate physical activity after the arrival of the hogs at the slaughter house and meat quality

INTRODUCTION

At our factory the majority of the hogs remain for 2 to 4 hrs in the slaughter house pens before slaughtering.

We wanted to know whether the conditions of this sojourn manifested itself in the quality of the meat.

For this experiment we also took into consideration the quantity of lactate in the plasma.

Manz and Mayer (2) found a rise in lactate following the handling of hogs during the transport from the farm to the killing place.

We wanted to investigate whether the level of lactate - also in relation to the level of corticosteroids and glucose - could give information about the meat quality to be expected.

MATERIALS AND METHODS

Forty animals were taken at random from the unloading platform at the time of arrival and divided into four pens, each 20 m long and 2.25 m wide.

Twenty of these animals were left unhindered in their pens for 3 hrs.

The other 20 animals were kept psychically and psychically active for three hours by moving them quietly from one end of the pen to the other.

All animals passed through the restraining corridor before entering the CO₂ immobilizer prior to slaughtering.

Blood samples were taken to determine the corticosteroids, glucose and lactet in the bloodplasma.

pH and cooking losses were estimated in the same manner mentioned in part. I.

RESULTS

Table 3 shows a frequency distribution of the relevant parameters.

In this case the reference numbers of the animals are given, enabling the reader to compare the values of the individual animals.

TABLE 3
FREQUENCY DISTRIBUTION OF PARAMETERS AFTER DIFFERENT TREATMENT IN THE PENS

Lactate mg/100 ml

	30-49	50-60	70-89	90-109	110-129	130-149	150-169	170-189	190-209
not moved		7-8	13	2-4-6 25-37 38-40	3-5-9- 31-32- 36	33-35	1-39		
moved	17-20	11-12 15-16 18-21 34	14-22 23-28	19-27	10-24 26-30				29

Glucose mg/100 ml

	70-89	90-109	110-129	130-149	150-169	170-189	190-209	210-229	230
not moved			3-4- 13-35	5-8	9-25 37-38	6-7-36 39-40	2-31 32	33	1
moved	26		16-17 20-23- 24-34	11-15 18-19 21-28- 29	10-12- 14-22- 27-30				

Corticosteroids / μ g/l

	22-26	27-31	32-36	37-41	42-46	47-51	52-56	56
not moved	6-8 38	3-9- 13-35	31-37	5-33- 36	7-32- 39	1-2 25	40	4
moved		10-23	11-12- 28	21-26- 30-34	18-27 29	22	16-17 24	14-15- 19-20

pH 24 hours

	5.9	6.0	6.1	6.2	6.3	6.4	6.5	6.6	6.7
not moved	38-40- 35	2-6- 8-33	3-4-7- 9-13- 31-32- 37-39	5-1	36	25			
Moved	16-21	11-12 28	17-18- 19-22 26-29- 34	27-10 15-24	20	30	14	23	

Cooking loss % (weighted averages of hams and shoulders)

	6	7	8	9	10	11	12	13	14
not moved		25	36	5-9-13- 32-37	1-3-4 6-33- 39	8-31- 35	2-38		7
moved	14		15-20- 24-30	10-22- 23-26- 34	19-27- 28	11-16- 18-21- 29	12-17		

Table 4 gives the average values of the parameters showing significant differences.

There was no significance in the differences between the averages of pH 24 hrs m. subscapularis, pH 24 hrs m. semitendinosus and cooking losses of the moved animals and the control group.

There appeared to be no significance in the differences found in the quality judgement of the hams and shoulders.

TABLE 4

AVERAGE VALUES OF THE PARAMETERS SHOWING SIGNIFICANCY

	moved animals		control animals	
	average	significance	average	significance
Corticosteroids ug/1	4.50	+	3.85	
Glucose mg/100ml	135.5		166.2	+++
Lactate mg/100ml	83.9		111.5	+++
Rigor shoulders	11.2	+	9.3	
Rigor hams	11.4	+	10.9	
pH 24 hrs m.adductor	6.13	+	5.97	
Cooking loss shoulder %	7.25		7.89	+

+++ $p = \leq 0.005$

+ $p = \leq 0.2$

DISCUSSION

The lower values of lactate and glucose in the moved animals could have three possible explanations:

- Glycogen reserves have been further depleted.

As a consequence, stress just before the slaughtering procedure cannot mobilize the usual quantity of carbohydrate for energy.

- the moved animal became more or less used to being handled.

In comparison with the control group the effect of transportation to the CO₂ immobilizer on the nervous state of the hogs is now relatively reduced.

- A combination of both

The first supposition is in accordance with the observations of Manz and Mayer, who found only an insignificant rise in lactate caused by the actual slaughter procedure.

However a more significant higher value of pH 24 hrs should then be expected.

The higher values of corticosteroids are quite normal under these circumstances.

GENERAL REMARKS

The dispersion of the values in the frequency distribution tables is mainly caused by differences in physiological conditions and pre-disposition of the individual

animals.

Obviously the value of the parameters used as tools in the prediction of meat quality is insufficient.

Further meaningful work in this direction is only possible with relevant new parameters, assessable in the living animal.

The criterion for such parameters is defined by the relationship between the muscle cell metabolism and post mortem biochemical reactions in the meat.

CONCLUSIONS

Part I

In this experiment no quality defects of the meat - resulting from passage of the hogs through the restraining corridor - have been found.

Part II

No effect on meat quality could be proved for the hogs that performed light to moderate physical exercise during the 3 hours in the slaughteringhouse pens.

Animals mentioned above, showed a somewhat higher level of blood plasma corticosteroids compared with the control animals.

Plasma glucose and lactate values were lower.

No significant correlation could be established between the above mentioned blood plasma components and meat quality.

LITERATURE

1. Luijeirnk J.H. and van Baal J.P.W. Proceedings 15th Eur.Meeting of Meat Res. Workers (1969).
2. Manz D and Mayer H. Tierärztliche Umschau 20 376-378 (1965).