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Some data concerning rigor development in muscle of pigs

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Introduction

Rigor development can be expressed in terms of stiffness c.q. rigor units if measured post mortem by way of the rigor meter according to Sybesma (1966).

Data about this rigor were collected in order to get information about:

1. the completion time of rigor in different slaughterhouses
2. the relation between rigor development immediately post mortem and the consistence of the meat 24 hours later
3. the relation between rigor development and the meat percentage of the ham.

Methods and material

1. In 4 different slaughterhouses the completion time of rigor was followed. This was done by measuring successively 144 pigs four times post mortem at 45 min., 2, 3 and 4 hours.
   The rigor was thought to be complete when the stiffness was 10 rigor units or more.
   In three out of four slaughterhouses already 90% of the carcases measured were stiff two hours post slaughter. In the fourth plant the rigor course of 33 animals was as follows (table 1).

Table 1. Rigor course in pigs at one slaughterhouse expressed in % (n = 33)

		45 min.	2 h.	3 h.	4 h.
complete rigor	(≥10)	24	70	91	94
onset of rigor	(>6, < 10)	39	27	9	6
no rigor	(≤6)	36	3	-	-

In this slaughterhouse after a time course of 2 hours only 70% of the carcases showed a complete rigor mortis. The differences of the development of rigor between the slaughterhouses might be due to differences in slaughter methods, pigs and days.

2.a. In order to get information about influence of the carcase quality on the rigor development 520 pigs classified as EAA (European Common Market System) were subjected to this measurement 45 minutes post mortem. These EAA pigs may have a backfat thickness of ≤ 20 mm at a carcase weight of $\geq$ 70 kg and they must have a high fleshiness score.
From these 520 meaty pigs 60.5% was already stiff on the time of measurement.

b. The next day the consistence of the cut of the loin was measured with the same apparatus. At this time the counter pressure, also defined in rigor units, doesn't reflect the rigor but the consistence.
In table 1 the consistence of the different quality scores that ranged from one (good) till four (bad, PSE) is given.

Table 1. The consistence of loins of different meat quality (n = 520)

Score	n	consistence
1 (good)	130	8.1
2 (acceptable)	164	6.8
3 (not acceptable)	130	6.2
4 (bad)	96	5.5

The differences between the quality classes proved to be all statistically different ($P \leq 0.02$).
When split into the rigor development of the m.semimembranosus 45 min. post mortem it could be observed that within every quality class a rapid rigor development corresponded with a better consistence of the m.long.dorsi (table 2).

Table 2. The relation between the rigor development in the ham and the consistence of the meat measured 24 hours later at the loin cut.

	Consistence quality score			
	1 (good)	2	3	4 (PSE)
rigor ≥ 10	8.4 ± 2.1	7.1 ± 2.1	6.4 ± 2.0	5.7 ± 2.0
onset of rigor > 6, < 10	8.0 ± 2.1	6.6 ± 1.7	5.7 ± 0.7	5.0 ± 0.9
no rigor ≤ 6	6.7 ± 1.9	5.6 ± 1.7	4.8 ± 0.5	---------

The rate of rigor development seems to have a very clear effect on the consistence of the meat cut 24 hours later.

3. As was suggested in the second part of this paper the carcass quality is related to the rate of rigor mortis development.
The following data give information about the relation between fleshiness and meat percentage on one side and rigor development expressed as stiffness 45 minutes post mortem on the other.
In table 3 classes of meat % are divided over the 1A and 1B carcase classification groups.

Table 3. The relation between the rate of rigor development, the meat % and the carcase classification.

		Meat % expressed in ham %			
		20 and<	20 - 21	21 - 22	22 and more
1A	n	14	40	75	104
	rigor units	5.4 ± 3.1	5.4 ± 3.0	5.3 ± 3.1	5.2 ± 3.0
1B	n	16	23	12	--
	rigor units	3.2 ± 3.0	3.1 ± 2.7	1.8 ± 2.1	--

Only in the 21-22 % the differences in stiffness were statistically significant ($P \leq 0.05$).

From these figures it is however clear that the level of rigor units (stiffness) 45 min. post mortem is in 1A pigs higher than in 1B pigs, which have a lower fleshiness score. The conclusion seems to be warranted that the fleshiness of a pig influences the rate of rigor development more than the meat percentages although in general there might be a connection between these two. This agrees with the suggestions of Verdijk (1972).

Discussion and conclusion

Measurement of the rate of rigor mortis in the slaughter line can give several kinds of information.
The way of slaughtering in different slaughterhouses may induce differences in rigor development, so do genetic differences in pigs.

From the data presented in this report it was concluded that the fleshiness plays an important role in the post mortem muscle metabolism. More fleshy pigs show a quicker completion of rigor mortis.
Furthermore it could be proved that a higher rate of rigor development affects the consistence of the meat favourably 24 hours post mortem.

Literature

Sybesma, W. (1966) : Die Messung des Unterschiedes im Auftreten des rigor mortis in Schinken.
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Summary

The stiffness of the ham post mortem can be measured by a so called rigor meter based on the counter pressure principle.
Data have been collected concerning

- the development of the stiffness post mortem
- the relation between stiffness 45 minutes post slaughter and the softness of the loin eye cut 24 hours later
- the relation between stiffness 45 minutes post mortem and the conformation and meatiness of the ham.

After two hours post mortem 90% or more of the carcases were stiff (n = 144).
Stiffness of the ham 45 min. post mortem was negatively correlated with the consistency of the m.long.dorsi cut measured by the same rigor meter 24 hours post slaughter.
Within the same quality score of this cut however the stiffness was positively correlated with the consistency.
Regardless of the meat % a better conformation resulted in a higher rigor score 45 min. post mortem which means a rapid development of stiffness c.q. rigor mortis.

QUELQUES DONNEES CONCERNANT LE DEVELOPPEMENT DE LA RIGOR MORTIS DANS LE MUSCLE DE PORC

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Résumé :

La rigidité du jambon post mortem peut être mesurée par un appareil (rigormètre) basé sur le principe de la contre-pression.

Des études ont été développées concernant :

- le développement de la rigidité post mortem.

- la relation entre la rigidité 45 minutes après abattage et la consistance de la noix de cotelette 24 h plus tard.

- la relation entre la rigidité 45 minutes après l'abattage et la conformation et la quantité de viande dans le jambon.

- 2 heures après la mort ,90 % (ou plus) des carcasses étaient raides (n = 144) la rigidité du jambon 45 minutes post mortem était en corrélation négative avec la consistance du longissimus dorsi mesurée sur une coupe avec le même appareil.

Cependant à l'intérieur des mêmes notes sur cette coupe la rigidité était en corrélation positive avec la consistance sans égard du pourcentage de viande,; une meilleure conformation donnait une plus forte note 45 minutes post mortem ce qui signifie un développement plus rapide de la rigor mortis.

Einige Angaben über die Entwicklung der rigor mortis im Schweinemuskel

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Zusammenfassung :

Die Schinkenstarre post mortem kann mit einem Messgerät (Rigormeter) nach dem Prinzip des Gegendrucks ermittelt werden.

Folgende Angaben wurden geprüft :

- Die Entwicklung der Starrheit post mortem.

- Die Beziehung zwischen der Starrheit 45 Minuten nach dem Schlachten und der haltbarkeit des Kotelettmuskels 24 Stunden später.

- Die Beziehung zwischen der Starrheit 45 Minuten nach dem Schlachten und der Zusammensetzung und dem Fleischanteil des Schinkens.

90 % (oder mehr) der Schlachtkörper waren starr 2 Stunden nach dem Schlachten (n = 144).

Eine negative Korrelation wurde zwischen der Schinkenstarre 45 Minuten post mortem und der haltbarkeit des m. longissimus dorsi festgestellt, die beim Muskelquerschnitt mit dem selben Gerät gemessen wurde.

Zwischen den selben Ergebnissen bei diesem Querschnitt war jedoch die Starrheit mit der Haltbarkeit positiv korreliert.

Ohne den Fleischanteil zu berücksichtigen ergab eine bessere Zusammensetzung ein höheres Ergebnis 45 Minuten post mortem ; das bedeutet eine schnellere Entwicklung der rigor mortis.