67 47

INSTITUUT VOOR VEETEELTKUNDIG ONDERZOEK

"SCHOONOORD"

(RESEARCH INSTITUTE FOR ANIMAL HUSBANDRY
"SCHOONOORD")

DRIEBERGSEWEG 10D - ZEIST (THE NETHERLANDS)

The Effect on Meat of Differences in Temperature and Humidity

Dr.W.Sybesma and Jeannette C.M.de Heer

IXth Conference of European Meat Research Workers,
Budapest, September 4-11-1963.

THE EFFECT ON MEAT OF DIFFERENCES IN TEMPERATURE AND HUMIDITY

INTRODUCTION

The frequency of pale, watery and soft meat in pigs is due to environmental factors. This defect in meat quality is seen more in summer than in winter, so that the temperature is thought to play a particularly important role. Theoretically the higher environmental temperature in summer can effect meat quality both before and after slaughter. Bendall (1960) showed that a rapid decrease in temperature, especially below the 25°C level is essential for the post-mortem metabolism.

The pre-slaughter effect of temperature has been investigated by Sayre, Briskey, Hoekstra and Bray (1961). They gave the animals a pre-slaughter change to a cold environment, thereby improving the meat quality. But this treatment was comparable to a situation of acute stress, whereas our aim was to imitate climatic differences to a greater extent. We whished to ascertain the importance of the temperature level before slaughter.

MATERIAL AND METHODS

Compartments:

The experiments were carried out with two replicates, there being two groups to an experiment. A Week before slaughter two groups were placed in two different compartments. As far as possible Compartment I was kept at a constant temperature(20°C) by means of thermostatic control. The temperature in Compartment II fluctuated according to the ambient temperature. The temperature and humidity were recorded on a thermohydrograph. The compartments had a dry fodder (14% protein) ad lib.system. Ventilation in CI was sub-normal, while in CII the air was replenished by means of slots provided underneath the windows; this was found to be a very reliable system.

In the third experiment the humidity in CI was increased by spraying the passage floor with water.

The pigs: The pigs were of the Large White race (gilts and barrows) ranging in weight from 95 to 110 kilograms. The animals were randomised in two groups. The total numbers in the various trials was 30 in Exp. I, 39 in Exp. II and 40 in Exp. III.

Transport: The group in Compartment I was conveyed to the slaughterhouse in a heated van. The same two vans were used in all experiments. The distance to the slaughterhouse was approximately 15 kilometres.

The slaughterhouse: The animals were slaughtered by electrical stunning as soon as possible after arrival (within 1 hour). The carcasses were conditoned chilled within 3 hours after stunning in the first experiment and within 2 hours in the other experiments. But the temperature in the slaughterhouse was around the freezing point in Exp. I and II, so that chilling began immediately during and after slaughter. The experiments I and II the 2 x 2 groups were slaughtered simultaneously. In the third experiment the groups were slaughtered successively.

Visual examination method:

24 hours after slaughter 4 meat samples from each half were judged by a visual method. The samples were cut from the m.long.dorsi, the m.psoas major, the m.pectoralis anterior profundus, and the m.semitendinosis. Owing to certain irrelevant factors the semitendinosis could not be judged, so that only the results of the first three samples will be given. The meat quality was classified as follows by means of the visual method:

1 : wet, pale and soft meat.
2 : pale, soft and dry meat.
3 : watery meat of good colour.
4 : normal meat.

Categories 1 en 2 together formed the group of inferior meat quality, while meat in categories 3 and 4 was considered to be normal.

Laboratory methods:

Transmission values test: After examination the samples were used for the transmission value test (Hart, 1961).

Thyroid test of Lever: (1948) The number of cells per follicle were counted and the diameter measured (under the microscope in Bouin-fixed thyroid slices stained with haemalin erythrosine. This method provides information on the histological thyroid function level.

EXPERIMENTS

Experiment I

This experiment was performed on 30 animals from 11th to 18th December, 1962.

Climatic differences between the groups are shown in table 1

Table 1

Experiment I (11 - 18 December)

	Cold (K I)		Warm (W I)	
	rel.humid. %	temp. (°C)	rel.humid. %	temp(°C)
2nd. day	92	10	86	20
3rd. day	85	9	92	19
4th. day	85	7	90	20
weekend 2½days	94	8	98	19

The temperature (°C) and rel.humidity in Experiment I

The data were calculated by means of a planimeter.

Meat quality: Table 2 shows the results of the visual examination and the transmission value test.

	Cold (K I)		Warm (W I)	
Name of sample	Number (%) degenerated samples (V.ex < 2)	Av.trm.value all samples	Number (%) deg.samples (< 2)	Av.trm.value all samples
m.long.dorsi	4 (27)	33 ± 5,9	8 (53)	50 ± 7,7
m.psoas major	6 (40)	37 ± 5,4	5 (33)	32 ± 4,5
spect.p.ant.	9 (60)	26 ± 5,5	7 (47)	24 ± 4,6

Table 2: The number of inferior meat samples and average of transmission value in Experiment I.

The minimum difference in the average temperature was 10°C and the maximum 13°C.

The relative humidity was fairly high in both groups. There was hardly any evidence that the differences in temperature before slaughter affected the meat quality. There was only a slight difference between samples of the m.long.dorsi. In the warm group (W I) 8 samples were classified by visual judgement as inferior, as against 4 samples in the cold group (K I)

The differences in the transmission value had a (statistical) probability of 10 per cent.

Experiment II

The second experiment was performed on 30 animals from 8th to 15th January 1963.

Climatologic conditions.

Table 3 shows the average of temperature and the relative humidity

Experiment II (8 - 15 January)

	Cold (K II)		Warm (W II)	
	rel.humid. %	temperature (°C)	rel.humid %	temperature (°C)
2nd day	81	4	68	20
3rd day	78	2	64	19
4th day	79	1	72	17
weekend 2 days	83	3	65	20

Table 3: The temperature (°C) and rel.humidity in Experiment II.

Meat quality

Table 4 reports the results of the visual examination and the average transmission values per group (table 4)

	Cold (K II)		Warm (W II)	
Name of sample	Number (%)degenerated samples (V.ex ≤ 2)	Av.trm.value all samples	number (%) deg. samples(V ex.≤2)	Av.trm.value all samples
M.long dorsi	3(15)	19 ± 2,4	3(16)	23 ± 4,7
M.psoas major	7(35)	28 ± 4,7	5(26)	20 ± 2,0
M.pect.p.ant.	7(35)	24 ± 3,6	4(21)	16 ± 1,2

Table 4: The number of inferior meat samples and the average of transmission value in Experiment II.

The minimum difference in temperature between the groups was 16°C and the maximum 17°C. The relative humidity was very low in the warm group (W II). To our surprise the meat quality in the cold group (K II) was somewhat poorer than in the warm group (W II). The differences in the transmission values of the combination m.psoas and m.pectoralis was significant (P 0,01)

Thyroid test: Table 5 shows the thyroid values (table 5)

period	n	Cold d/n value	Warm d/n value
II	10	1,94 ± 0,05	1,94 ± 0,06
III	10	1,89 ± 0,04	2.11 ± 0,03

Table 5 Thyroid data. The diameter/number of cells ratio per follicle in different groups.

Experiment III

The third experiment was performed on 40 animals from 29th January to 4th February 1963.

Climatic conditions: Table 6 shows the climatic conditions.

Experiment III (29 January - 4 February)

	(Cold (K III) rel.humidity %	Temperature (°C)	Warm (W III) rel.humidity %	temperature (°C)
2nd.day	78	5	73	20
3rd.day	74	4	72	20
4th.day	76	4	69	25
weekend 2 days	77	4	80	20

Table 6: The temperature (°C) and rel.humidity in Experiment III.

Meat quality: The meat quality data are recorded in table 7.

Name of sample	Cold (K III) Number (%)dege- nerated samples (V.ex < 2)	Av.trm.value all samples	Warm (WIII) number(%)deg. samples(V.ex <2)	Av.trm.value all samples
M.Long dorsi	6(30)	20 ± 4,3	10(50)	28 ± 4,2
M.psoas major	8(40)	24 ± 2,9	12(60)	38 ± 4,5
M.pect.p.ant.	10(50)	15 ± 1,4	9(45)	17 ± 2,5

table 7:The number of inferior meat samples and the average of transmission value in Experiment III.

Thyroid test: The thyroid test results are shown in table 5. The minimum difference in temperature was 15°C and the maximum 21°C. Owing to a defect in the electrial equipment on the fourth day the temperature rose to 25°C. At first the relative humidity was fairly low in the warm group (W II) but water sprayed on the passage floor raised the relative humidity to an average of 80 per cent during the last days. In this experiment significant differences were found in meat quality between the groups (tbale 7).
In 10 animals of each group there was a significant difference between the results of the thyroid examination (table 5).

DISCUSSION

The differences in temperature alone are probably not enough to create differences in meat quality. In experiment I and II there was an indication that the higher temperature had a bad effect on the meat quality. In experiment II, however, the warm group was even better than the cold group (although not statistically)
In our opinion the environmental circumstances in K II and K III were comparable. The meat quality did not differ greatly, so that the possibility of genetic differences between the experimental groups may well be ignored. If so, the difference in meat quality between W II en W III is due to a difference in relative humidity at about the same temperature. Is this assumption justified ?.
It is known from Bianco's work (1961) that relative humidity in connection with temperature can interfere with the dissipation of body heat by evaporation. Under the conditions prevailing in W III the heat load was probably more severe than under those in W II. The thyroid data point in the same direction. In W II this reflection of the thyroid function is significantly lower than in W III. These results may mean that the function of the thyroid was higher under the same temperature conditions when the humidity was low. From inspection of the cold group (K II) with a normal relative humidity, which has almost the same meat quality as the warm group (W II) with the low humidity, it can be seen more clearly that relative humidity is more important than temperature.

CONCLUSION

We conclude from these experiments that

a) differences in pre-slaughter climatic conditions may cause differences in meat quality;

b) these differences in meat quality are not solely due to temperature effects. The influence of the relative humidity is possibly even more important.

SUMMARY

The effect of different pre-slaughter temperature levels on the meat quality was investigated in experiments with a total number of 109 Large White pigs. One temperature level was fixed at 20°C (this was not possible in all cases). The meat quality was ascertained by visual examination and the transmission value method.
In experiment I the higher temperature was only found to have a slight effect on the quality of the m.long.dorsi. The temperature difference was about 10°C.
In experiment II, in which the temperature difference was about 15°C, the cold group had even poorer meat quality (the differences were not statistically significant).
In experiment III, in which the difference in temperature was about 17°C the meat quality in the warm group differed from the cold group to a statistically significant extent. The better quality in the cold group was probably due to a higher thyroid function, possibly to a higher metabolism. Evidence was found that the relative humidity is possibly as important or even more important than the temperature level for the frequency of the pale, watery and soft meat in pigs.

REFERENCES:

1) Bendall, J.R., Post Mortem Changes in Muscle.
Structure and Function of Muscle (Vol.III)Editor C.H.Bourne. Academic Press New York, London 1960.

2) Bianca, W. Heat tolerance in Cattle. Intern Journal of Biometeorology (1961) Vol. 5 p 5 - 30.

3) Hart, P.C. Seventh Meeting European.
Meat Research Workers, Warsaw (1961)

4) Lever, J. Proc. Kon.Ned.Akademie van Wetenschappen Amsterdam. Series C (51),1302-1309, 1948.

5) Sayre, R.N., Briskey, E.J. Hoekstra, W.G., Bray,R.W. Effect of pre-slaughter change to a cold environment on characteristics of pork muscle.
J.Animal Sci (1961) Vo.20 p 487-492.

THE EFFECT ON MEAT OF DIFFERENCES IN TEMPERATURE AND HUMIDITY

ZUSAMMENFASSUNG

In Versuchen mit insgesamt 109 Schweinen der Rasse "Large White" wurde der Einflusz verschiedener Temperaturen vor der Schlachtung auf die Fleischqualität untersucht. Die Qualität wurde mit Hilfe einer visuellen Beurteilung und mittels der Transmissionswert-methode bestimmt an der M.long.dorsi, der M.psoas major und der M.pect.prof.ant. Die Ergebnisse des 1. Versuches zeigten nur auf die Qualität des M.long.dorsi eine geringe Einwirkung. Der Temperaturunterschied betrug etwa 10°C.
Im 2.Versuche, in dem der Temperaturunterschied etwa 15°C war, wurde bei der Kältegruppe eine schlechtere Fleischqualität gefunden (die Unterschiede waren statitisch nicht signifikant).
Im 3.Versuche, mit einem Temperaturunterschied von etwa 17°C, ergaben sich zwischen der Wärmegruppe und der Kältegruppe statistisch signifikante Underschiede in der Schlachtqualität. Die bessere Qualität der Kältegruppe is wahrscheinlich einer hoheren Schilddrüsenfunktion zuzuschreiben.
Es konnte weiterhin gefolgert werden, dasz die relative Feuchtigkeit wahrscheinlich von gleicher Bedeutung oder gar von grószeren Bedeutung für das Vorkommen van blass-wässrigem Fleisch von weicher Konsistenz ist als die Temperatur.

RESUMÉ

L'influence de différentes températures avant l'abattage sur la qualité de la viande a été étudiée dans des expériences comprenant au total 109 porcs de race Large White. Une température a été fixée à 20°C.
La qualité fut estimée à l'aide de l'estimation visuelle et du méthode de la valeur de transmission.
Dans l'expérience I on a constaté que la temperature plus élevée n'avait qu'une influence assez peu sur la qualité du M.long.dorsi.
La différence de température se monta à 10°C environ.

Dans l'expérience II, dans laquelle la différences de température était de 15°C environ, le groupe exposé à la température basse montra même une qualité plus mauvaise (les différences observées n'étaient pas significatives).

Les résultats de l'expérience III, dans laquelle la differénce de température était de 17°C environ, présentaient une qualité significativement différente entre le groupe exposé à la temperature élevée et ceci exposé à la température basse. La qualité supérieure du groupe exposé à une température basse pourrait être due à une fonction thyroïdienne plus élevée. De plus, on a pu constater que la humidité relative est probablement de même importance, si non plus importante, que la température pour la fréquence de la viande exsudative chez le porc.

The Effect on Meat of Differences in Temperature and Humidity

Errata

pag. 1	line 16	for "whished" read "wished"
pag. 2	line 18 and 19	for "Exp. I and II" read "Exp.II and III"
pag. 7	line 9	for "tbale 7" read "table 7"
	line 14	for "Experiment I and II" read "Experiment I and III".
	line 24	for "Bianco" read "Bianca".