PROCESSING OF PSE AND NORMAL HAMS

J.F.G. KLINGBIEL, R.T. NAUDé AND R. VAN ESSEN

Animal and Dairy Science Research Institute, Irene
South Africa

In recent surveys carried out in South Africa the incidence of PSE muscles in pig carcasses has been comparable to that of other countries in the world. In order todetermine the financial loss incurred under practical factory conditions, PSE and normal hams were processed in a bacon factory. Hams were classified as PSE (n=12) when the pH_1 values of three muscles in each carcass were $\leq 6,0$, the $pH_f \leq 5,7$ and the EEL reflectance measurement of the M.gluteus meduis (24 hours, post mortem) was ≥ 40. In the caseof normal hams (n=12) the pH_1 values had to be $\geq 6,6$, $pH_f \leq 5,7$ and the reflectance values ≤ 34. The mean pH_1 values of the M.semimembranosus of PSE and normal hams were 5,89 and 6,89 respectively and the reflectance measurements were 44,08 and 31,92. In both cases the pH_f value was 5,38.

The final yields after processing were 92,1% in the case of PSE hams and 98,6% for normal hams. In the light of present South African ham prices, this yield difference represents a financial difference of R0,52 per 4kg ham.

FABRICATION DE JAMBONS P.S.E. ET DE JAMBONS NORMAUX

J.F.G. KLINGBIEL, R.T. NAUDé ET R. VAN ESSEN

Institut de Recherche de Science Animale et de production laitière, Irene, Afrique du Sud

A la suite d'examens récents menés en Afrique du Sud, l'incidence de P.S.E. dans les carcasses de porc s'est révélée comparable à celle des autres pays du monde. Afin de de'terminer la perte financière qui se produit dans les conditions pratiques de la fabrique; des jambons P.S.E. et normaux ont été fabriques dans une fabrique de lard - Les jambons furent classés comme P.S.E. (n=12) quand les valeurs pH_1 de trois muscles de chaque carcasse furent de $\leq 6,0$, le $pH_f \leq 5,7$ et la mesure de réflexion EEL du M.glutens medius (24 heures post mortem) de ≤ 40. Dans le cas des jambons normaux (n=12) les valeurs pH dûrent être de: $\geq 6,6$, le pH_f: $\leq 5,7$ et les valeurs de réflexion: ≤ 34. Les valeurs moyennes pH_1 du M.semimembranosus des jambons P.S.E. et des jambons normaux furent respectivement de 5,87 et 6,89, et les mesures de réflexion de 44,02 et 31,92. Dans les deux cas la valeur pH_f fut de 5,38.

Les rendements finaux après fabrication furent de 92,1% dans le cas des jambons P.S.E. et de 98,6% pour les jambons normaux. Compte tenu des prix actuels du jambon sud-africain, la différence de rendement représente une différence financiere de R0,52, par jambon de 4 Kg.

VERARBEITUNG VAN PSE UND NORMALEN SCHINKEN

J.F.G. KLINGBIEL, R.T. NAUDé UND R. VAN ESSEN

Forschungsinstitut für Tier- und Milchwissenschaft,
Irene, Südafrica

Untersuchungen haben das Vorkommen von PSE Schlächtkorpern unter Schweinen in Südafrica angezeicht. Um den finanziellen Verlust der unter praktischen Fabriksumständen auftritt, bestimmen zu könen, wurden PSE und, normaler Schinken in einer Fleischfabrik verarbeitet. Schinken wurde als PSE (n=12) bezeichnet wënn die pH_1 Werte von drei Muskeln in jedem Schalachtkörper $\leq 6,0$, $pH_f \leq 5,7$ und EEL Reflektierungsmessung der M.gluteus medius (24 Stunden post mortem) ≥ 40 waren. Für normale Schinken (n=12) waren die Werte $pH_1 \geq 6,6$, $pH_f \leq 5,7$ und der Reflektierungswert ≤ 34. Der durchsehnitts pH Wert der M.semimembranosus van PSE und normalem Schinken waren jeweils 5,89 und 6,89, und die Reflektierungsmessung 44,08 und 31,92. In beiden war der pH_f Wert 5,38.

Der Ertrag nach der Verarbeitung war 92,1% für PSE Schinken und 98,6% für normalem Schinken. Zu den herschenden südafrikanischen Schinkenpreisen ergibt diese Ertragsdifferenz eine finanzielle differenz von R0,52 pro Schinken von 4 kg.

ПЕРЕРАБОТКА P.S.E. И СТАНДАРТНЫХ ОКОРОКОВ

J.F.G. KLINGBIEL, R.T. NALIDÉ AND R VAN ESSEN

ИНСТИТУТ ПО ИССЛЕДОВАНИЮ О ЖИВОТНОВОДСТВЕ И МОЛОЧНО-ХОЗЯЙСТВЕННОЙ НАУКЕ. АЙРИНН, ЮЖНАЯ АФРИКА
[ANIMAL AND DAIRY SCIENCE RESEARCH INSTITUTE IRENE, SOUTH AFRICA]

Недавно проведенные в Южной Африке обследования показали что частота свиных туш P.S.E. сравнима с тем же явлением в других странах света. Чтобы определить финансовый убыток при обычных фабричных условиях, P.S.E. и стандартные окорока были переработаны в котильне. Окорока были распределены по 2 разрядам - P.S.E. [n=12] когда величина pH мускулов в каждой туше равнялась $\leq 6,0$, $pH_f \leq 5,7$, и EEL измерение отражения M. gluteus medius [24 часа после убоя] было ≥ 40. В стандартных окороках [n=12] величина pH должна была быть $\geq 6,6$, $pH_f \leq 5,7$ и величина отражения ≤ 34. Средняя величина pH M. semimembranosus P.S.E. и стандартных окороков была соответственно 6,83 и 6,89 и измерение отражения были 44,08 и 31,92. В обоих случаях величина pH_f была 5,38

Окончательные результаты переработки были 92,1% в окороках P.S.E. и 98,6% в стандартных окороках. Принимая во внимание цены на ветлину в Южной Африке это делает разницу в 0,52 ранда на каждый окорок весом в 4 килограмма.

PACKAGING FRESH AND CURED MEAT

PROCESSING OF PSE AND NORMAL HAMS

J.F.G. KLINGBIEL, R.T. NAUDÉ & R. VAN ESSEN

Animal and Dairy Science Research Institute
Irene, South Africa

The technological disadvantage of processing PSE pork has been emphasized in many experiments (Wismer-Pedersen, 1959, 1960a, 1960b; Briskey, 1964; Karmas & Thompson, 1964). This has not been demonstrated in South Africa even though Naudé and Klingbiel, (1973) based on extensive surveys, established that almost 30% of the pigs slaughtered in South Africa develop PSE muscles post mortem. It was therefore decided to process hams of PSE and normal baconer carcasses in order to compare the yields of fully cooked hams produced under practical factory conditions.

Procedure

Classification of hams

On the first day of the experiment pH measurements (45 minutes post mortem) were taken with a combination glass electrode fitted to a portable Polymetron pH-meter in the M. longissimus dorsi, M. semimembranosus and M. adductor femoris of grade A bacon carcasses (C + K fat measurement ≤ 50 mm, mass of 60 to 75 kg). Twenty five carcasses with pH_1 values ≤ 6,0 in the M. longissimus dorsi, were classified as PSE. Another group of 25 carcasses with pH_1 values higher than 6,6 was chosen as normal controls.

Directly after slaughter, the carcasses were stored in a cold room for 24 hours after the hindlegs had been cut from the selected carcasses. The final pH (24 hours post mortem - pH_f) of the semimembranosus muscles was also taken to ensure that hams could be chosen in which post mortem glycolysis had been completed The reflection value (colour) of the gluteus medius muscle was determined with an EEL-reflectometer.

From each of the preliminary groups fo 25, 12 gammons were eventually selected:

Group I (PSE) : Low pH_1-values (≤6,0)
Low pH_f-values (≤5,7)
High reflection value (= pale coloured) (≥40)

Group II (Normal) : High pH_1-values (≥6,6)
Low pH_f-values (≤5,7)
Low reflection value (= dark coloured) (≤34)

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The carcasses from which these two groups were chosen did not differ significantly in carcass mass or fat thickness.

Processing

The 24 gammons were all deboned, skinned, defatted and trimmed for cooking. Subsequently the mass of each was determined (the "raw ham mass"). Following the preliminary preparation, the raw hams were stored overnight in a cold room for 12 hours and then pumped with brine with a multineedle pumping machine. The mass of each ham was measured prior to and following brine pumping.

The brine used was a solution of a common commercial salt mixture (also containing polyphosphate salts) used for curing hams prior to cooking. The pumping machine was set in such a way to ensure that each ham would attain a mass of approximately 125 per cent of its raw mass (Moerman, 1967). The mass was measured again (Mass after brining) and the hams cured in cold storage for 3½ days.

The mass of each ham was measured before it was cooked (Mass before cooking). Each ham was placed in a pearshaped mould, Type 1B and the 24 moulds packed into a steam oven with a temperature of 85°C. Hams were cooked for four hours at which stage an internal temperature of 70°C was reached in the centre of the ham. After removing the mould from the oven, they were cooled overnight. Each cooked ham was removed from its mould, the extraneous gelatine removed and the mass measured again (Mass after cooking). The cooked hams were cut and reflection measurements of the M. gluteus medius were taken.

The average mass of the hams determined at each stage of the process was calculated. Mass changes were expressed on a percentage basis. The F-test, in a one-way analysis of variance (Snedecor, 1956), was applied to establish significant differences between the two groups of hams.

Results and Discussion

In order to select comparable groups of PSE and normal hams pH_1 readings were taken of 300 carcasses of which 25 (8,3%) were classified PSE. Formerly a figure of 8,6 per cent was determined in a survey undertaken at this factory (Klingbiel & Naudé, 1971).

The average pH_1, pH_f and reflection values upon which the selection into PSE and normal groups was based, are given in Table 1. The pH_1 values of the muscles of the PSE carcasses all differed significantly ($P < 0,01$) from the pH_1 values of those of the normal carcasses. The PSE hams originated from carcasses with pH_1-values of 5,73; 5,75 and 5,89 in the longissimus dorsi, adductor femoris and semimembranosus muscles respectively while the relevant values for the normal hams were 7,07; 6,78 and 6,89. The pH_f-value of the semimembranosus muscle of 5,38 in both groups is an indication that all the hams were from carcasses which had sufficient supplies of muscle glycogen at the time of death to ensure a normal complete post mortem glycolysis.

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Table 1 - Measurements on fresh muscles

Group	LD pH_1	Add pH_1	SM pH_1	SM pH_f	Reflection value
PSE n = 12	5,73	5,75	5,89	5,38	44,08
NORMAL n = 12	7,07	6,78	6,89	5,38	31,92
F test	P<0,01	P<0,01	P<0,01	-	P<0,01

LD : M. longissimus dorsi
Add : M. adductor femoris
SM : M. semimembranosus

The higher the values on the EEL-reflectometer the lighter the colour measured. Therefore PSE hams were lighter (reflection: 44,08) than hams (reflection: 31,92) ($P < 0,01$) which were "normal".

The average "raw ham mass" was 4283,8g for the PSE group and 4041,7g for the normal group (Table 2): the difference was not significant.

Yields of processed hams

In Table 2 the mass losses are given as percentages. During overnight cooling of fresh raw hams, the PSE hams lost 1,1 per cent of their mass and the normal hams only 0,4 per cent - this difference was highly significant ($P < 0,01$).

Table 2 - Percentage mass loss during processing

	During 12h cold storage	During 3½ days curing	During cooking	During entire process
PSE	1,1	6,8	19,9	7,9 (336,7g)
NORMAL	0,4	6,8	15,9	1,3 (52,9g)
F Test	P<0,01	-	P<0,01	P<0,01

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After brining the PSE hams had a mass of 5289,58g and the normal hams 5092,50g. The difference in percentage increase (24,7 per cent for the PSE and 26,4 per cent for the normal hams) was not significant.

During the 3½ day curing in cold storage both groups of hams lost 6,8% of the mass after brining (Table 2). The presence of phosphate salts in the brine and its effect on the water binding capacity of muscle proteins most probably resulted in the equal mass loss during curing.

During cooking, the PSE hams lost 978,25g and the normal hams 755,3g which is 19,9 and 15,9 per cent of their masses before cooking (Table 2). The percentage loss difference between the two groups ($P < 0,01$) is in agreement with the results of Moerman (1967) who worked with small portions of pork and found a cooking loss of 21,9 per cent for PSE and 14,6 per cent for normal pork. Furthermore the cooking losses found in this experiment approximates those of Leest and Van Roon (1968) who obtained a 10,4 per cent cooking loss for meat with a pH_1 of 6,0 and a 7,8 per cent cooking loss for meat with a pH_1 of 6,6.

From the stage of deboning until the final cooked product, the PSE hams lost 336,7g and the normal hams 52,9g of their mass i.e. a percentage loss of 7,9 and 1,3 per cent for PSE and normal hams respectively (Table 2). This resulted in a nett yield of 92,1% for PSE and 98,9% for normal hams ($P < 0,01$). The greatest portion fo the mass loss occurred during the cooking process and the greatest difference in mass loss also occurred during this stage.

Colour of the final product

Table 3 shows the reflection values before and after processing. It is interesting to note a greater change in the colour of normal than of PSE hams during the entire process (i.e. 31,92 vs 64,67 and 44,08 vs 69,17 respectively).

Table 3 - Reflection values of ham muscles before and after processing

	Raw	Cooked
PSE	44,08	69,17
NORMAL	31,92	64,67
F test	P<0,01	P<0,05

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Conclusion

In this experiment the pH_1 and pH_2 and reflection values of muscles in bacon carcasses were successfully applied for the classification of PSE and normal hams. PSE hams yielded 6,6 per cent less cooked product than normal hams. The losses mainly took place during cooking. In addition to the lower yield of PSE hams, these were also paler in colour prior to and after cooking. Both these quality parameters are of economic importance.

Although mass losses of hams were investigated only during processing, it seems justified to predict higher mass losses from PSE pork during the manufacturing of other products such as Wiltshire bacon and canned hams. The 6,6% higher loss from the PSE hams, calculated at the present price of R8-00 per 4 kg cooked ham, results in a nett loss of R0,52 per PSE ham. Fortunately only 8,6 per cent of the pigs at this centre show the PSE condition, but similar losses might have a considerably higher impact at those centres where the incidence of PSE pork was found to be 12,9; 17,5; 28,6 and 71,9 per cent among baconer carcasses (Naudé & Klingbiel, 1973). When this loss is applied to the average calculated figure of the above authors of 29,6% assuming a 50% production of processed hams and a throughput of 500 baconers per day, the annual loss could amount to R10 000 per average sized bacon factory.

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