2. Preslaughter Handling and Slaughter Technology

The Effect of Rapid Chilling on Beef Quality

J. L. AALHUS, A. K. W. TONG, W. M. ROBERTSON AND S. D. M. JONES
RED MEAT AND BEEF PRODUCTION, AGRICULTURE CANADA, LACOMBE, ALBERTA, CANADA T0C 1S0

The following study was conducted to determine the effect of blast chilling on carcass weight losses, pH and temperature decline and meat quality in beef heifers ranging in fatness from 0 to 69 mm of backfat. A total of 632 sides were were subjected to one of three treatments: 1) Blast chilled for 3 h at -20 °C followed by conventional chilling (BL); 2) Electrically stimulated (470 V, 1.5 A, 60 Hz, 20 pulses/min, 1 min duration) followed by 3 h blast chilling followed by conventional chilling (ES/BL); and 3) Conventionally chilled for 24 hours at 2 °C (CONV). Cooler shrink after 24 h was greatest in the CONV, intermediate in the ES/BL and smallest in the BL carcasses (P=0.0001). Within the CONV treatment, increasing backfat depth tended to decrease the amount of cooler shrink. Surprisingly, within the BL treatment, increasing backfat depth tended to increase the amount of cooler shrink. For both the longissimus and semimembranosus muscles the rate of temperature decline was similar between the BL and ES/BL carcasses, reaching temperatures below 10 °C within 10 h post-mortem. CONV carcasses had a slower rate of temperature decline reaching an average temperature of 10.5 °C in the longissimus and 12.3 °C in the semimembranosus at 10 h post-mortem. Despite having similar rates of temperature decline in both muscles in the BL and ES/BL carcasses, the BL carcasses had the slowest rates of pH fall, followed by the CONV carcasses, followed by the ES/BL carcasses. These differences in pH decline did not result in differences in shear value among treatments in the semimembranosus muscle. However, in the longissimus muscle BL carcasses had significantly higher shear values than CONV carcasses (8.28 vs. 7.81 kg, respectively; P=0.0001). ES/BL carcasses had shear force values that were almost 10% less than CONV carcasses (7.05 vs. 7.81 kg, respectively). There was no evidence that the differences in shear force among treatments resulted from cold-shortening since sarcomere lengths were identical (P=0.84). After 24 h, ES/BL carcasses had longissimus muscle colour that was superior to both the BL and CONV carcasses as determined by L*, a* and b* values (P=0.0003, 0.0001, 0.0001, respectively). After 6 d aging ES/BL carcasses had similar colour to CONV carcasses and both remained superior to the BL carcasses. This study indicates that blast chilling has some negative effects on objective measurements of beef quality. However, when carcasses are electrically stimulated prior to blast chilling, the resulting beef quality is similar to, or better than beef quality of conventionally chilled carcasses. Since backfat depth within a treatment had little influence on any of the quality traits, and since leaner carcasses had less cooler shrink than fatter carcasses when blast chilled, blast chilling of lean carcasses may be a viable chilling method.

The effect of transportation distance and preslaughter lairage time on the pigmeat quality

P. O. V. CULAU, J. M. OURIQUE and S. NICOLAIEWSKY
Faculdade de Agronomia da UFRGS, Porto Alegre, RS, Brasil

The aim of this work was to evaluate the effect of transportation distance from farm to abattoirs and preslaughter lairage time on the pigmeat quality. A total of 160 crossbred pigs (castrates and gilts) were slaugtered with approximately 90 kg live weight. Were used four transportation distance (10, 45, 80 and 115 km) and two preslaughter lairage times (6h and 24h) to form a 4x2 factorial trial. Muscle longissimus dorsi and semimembranosus pH and colour refletance measurement (at 45 minutes post mortem and after overnight cooling), slaughter weight and cool carcasses weight were examined. In the groups that had 80 or 115 km transportation distance and a lairage time of 6 hours, the average of pH1 were less than the other groups and thus PSE (pH1 < 6,0) carcasses frequency was greater. The refletance measures, using FOP (Fibre optic probe) indicated that the PSE (FOP greater than 151) frequency tends to decrease with the increase of transportation distance and was greater in the group of 24 hours lairage time. The DFD (pH2 ≥ 6,0 and FOP less than 119) frequency was greater for the lairage time groups of 24 hours. The transportation distances were not enough to affect the DFD frequency. The effect of sex, slaughter weight and cool carcasses weight were insignificant. It is difficult to change the distance from farm to abattoir, but the preslaughter lairage time can be prolonged or decreased according to the pigs necessity in order to improve the meat quality.

2

Antemortem stress and the variance of blood metabolites, cortisol and catecholamines in cattle

H.M. EICHINGER, M. GOLDBERG, BRIGITTE KRIEGLSTEIN, SABINE ROIGER AND G. BECK
Versuchsstation Thalhausen, Techn. Univ. München, W - 8051 Kranzberg, Germany
Institut für Physiologie, Physiologische Chemie und Ernährungsphysiologie, Tierärztliche Fakultät der LMU, Veterinärstr. 13, W - 8000 München 40, Germany

Physical activity, nutritional factors, aggression or infections can all cause very similar reactions in single blood metabolites, cortisol or catecholamines. The individual reaction may be also greatly influenced by genetic disposition and by long term influences from the environment.
It was the aim of this study to combine selected physiological parameters for an integrated evaluation of antemortem stress in cattle.
From 87 young Simmental bulls blood samples were taken just after transportation from the tail vena, and immediately after stunning intramortem from sticking blood. After centrifugation and deep freezing, samples were analysed enzymatically for glucose and lactate, by radio-immuno assay for insulin and cortisol, and by HPLC with postcolumn-derivatization and fluorometric detection for catecholamines. Transportation stress was evaluated by an appropriate protokoll. In the venous blood samples lactate values ranged from 1.0 to 22.3 mmol/l, glucose from 3.9 to 17.7 mmol/l, cortisol from 4.3 to 68.3 µg/l and insulin from 8.7 to 64.8 mU/l. First catecholamine analysis indicate for adrenaline 0.25 - 5.5 nmol/l and for noradrenaline 0.5 - 12.4 nmol/l. In the intramortem blood samples, ranges are 2.0 - 23.5 mmol/l for lactate, 4.7 - 16.4 mmol/l for glucose, 5.3 - 76.0 µg/l for cortisol, 8.3 - 84.6 mU/l for insulin, and catecholamine values exceeding 100 nmol/l. Analysis of variance, single and multiple regression between the parameters are used to identify specific reaction-types.

The effect of feedstuff composition, sex and day of slaughter on pork quality

G. EIKELENBOOM and A.H. BOLINK
Research Institute for Animal Production "Schoonoord", P.O. Box 501, 3700 AM Zeist, The Netherlands

A total of 64 crossbred pigs, consisting of gilts and castrates, were used to determine the effects of diets with different feedstuff composition on meat quality. An experimental feed containing cerials (35 % barley, 10 wheat), was compared with a (standard) control feed (37 % tapioca and 8 % sunflower meal extr.). Pigs were slaughtered in two batches, with one week interval. Pigs from the first batch were, by mistake, slaughtered immediately after arrival at the abattoir. Pigs from the second batch were subjected to the standard resting period of 2 hrs in lairage.

No significant differences in colour and driploss of longissimus dorsi muscle were found between feeding groups, but heating loss was significantly higher for the experimental feed. A lower ultimate pH was found in longissimus, semimembranosus and adductor muscle of gilts in comparison with castrates, resulting in higher heating losses. Highly significant differences in all meat quality traits indicative for PSE, were found between the two batches. These differences were even larger than those found previously between groups of pigs with different halothane-phenotypes. Pigs from the first batch, which did not rest before slaughter, showed inferior meat quality. Probably due to variation in duration of resting period in lairage, effect of day of slaughter appeared of much more importance for meat quality than the effect of feedstuff composition or sex.

Variations in Pig Muscle *Longissimus dorsi* glycolytic potential during transport and lairage- *In Vivo* Studies

X. FERNANDEZ *, M. MÅGÅRD and E. TORNBERG
Swedish Meat Research Institute, Box 504, 24424 Kävlinge, Sweden.
*, INRA- Porcine Research Center, Saint-Gilles, 35590 L'Hermitage, France.

The variations in pig muscle *Longissimus dorsi* (LD) glycolytic potential (GP, very close to glycogen content) were studied during i) a short transport of 2 h and ii) a 2 or 24 h lairage. The animals used were (Landrace x Yorkshire) x Hampshire crossbred. For both trials variations in GP were assessed *in vivo* by repetitive biopsy samplings on the same animal, thus allowing the exclusion of other possible interacting factors. Meat quality traits, *i.e.* pH_1 (45 min *post mortem*), pH_u and FOP (24 h *post mortem*) were also measured on m. LD.

Experiment 1. Four groups of 9 pigs corresponding to 4 rearing pens, were transported unmixed for 2 h. Biopsy samplings were performed immediately before and after transport. GP did not vary significantly during transport (-2.2%). As shown by *post mortem* pH and FOP values, no tendency toward PSE or DFD meat occurrence was observed. It was concluded that a short transport during which unfamiliar animals were not mixed, did not induce any apparent stressful conditions, as shown by the stability of muscle glycogen store.

Experiment 2. Six groups of five animals underwent one of the following treatments: 2 h lairage mixed or unmixed, 24 h lairage mixed or unmixed with access to water only, 24 h lairage mixed or unmixed with access to a sugar solution. Biopsy samplings were performed on arrival at the abattoir and after treatment. A significant glycogen depletion occurred during lairage (ranging from -12 to -16 %) except when pigs were fed liquid sugar. The extent of this depletion was irrespective of lairage duration or mixing. Values of pH_u were low ($pH < 5.5$) and did not vary significantly between the treatments since GP levels remained high, despite the lairage-induced depletion. This was attributed to the high muscle glycogen level characterizing the Hampshire crossbred pigs used in this experiment. These results suggested that interaction between breed and handling procedure may be important with regard to meat pH_u.

Pre-slaughter CO_2-anaesthesia in swine - Aspects upon neurophysiology and animal welfare.

A.FORSLID
Swedish Meat Research Institute, POB 504, S-244 24 Kävlinge, Sweden

In the discussion of pre-slaughter CO_2-anaesthesia in swine, the occurrence of increased muscular activity in animals has been under debate for many years. Are these transient motor reactions a manifestation of emotional stress or do they occur when animals are unconscious due to anaesthesia? It was of interest therefore, to study the electroencephalogram (EEG) during continuous CO_2-inhalation.The time of appearance of an EEG-pattern typical of anaesthesia was correlated with the time of appearance of increased motor activity usually seen during the initial phase of CO_2-exposure. Both 80% and 95% CO_2-concentration were used. The EEG was recorded via electrodes implanted over the frontal neocortex (80% and 95% CO_2) and into the dorsal part of the hippocampus.The most prominent finding of these studies was that an EEG-pattern typical of anaesthesia had developed in all swine a few seconds before the appearance of increased motor activity. Another experiment was aimed at studying the effect of CO_2-inhalation upon amygdalectomized animals. No difference in either the time of the appearance of the increased motor activity or the strength of this activity was observed when comparing amygdalectomized with normal pigs. After 15 seconds of CO_2-exposure, pronounced arterial hypercapnia, hypoxia and acidemia had developed. The observed changes in the EEG imply that the swine were unconscious before the appearance of the increased motor activity. The dramatic changes in the blood-gas parameters and blood pH were incompatible with consciousness. The absence of behavioural differences between normal and amygdalectomized pigs, while exposed to a high concentration CO_2 suggests that the motor reactions observed were caused by other mechanisms than those exerted by the amygdaloid nuclear complex.

The integrated result of these studies suggests that the increased motor activity temporarily observed rather early on during CO_2-exposure is a manifestation of neocortical disinhibition of subcortical motor-centres.

2

Electrical Stunning in Cattle and Sheep: Electrode Placement and Effectiveness

K. V. Gilbert, C.J. Cook and C.E. Devine

Meat Industry Research Institute of New Zealand (Inc.), PO Box 617, Hamilton, New Zealand

A key issue in livestock welfare is to ensure that animals do not suffer needlessly during slaughter. Preslaughter electrical stunning may provide such an assurance and fulfill another meat production need - that of animal movement control during slaughter and dressing procedures.

Our studies indicate the importance of stunning electrode placement in assuring humaneness. In this paper we present experiments demonstrating the dependence of effective stunning on adequate current flow through the brain. The level of current required is relatively low. Work in the sheep demonstrates that: skin, scalp, skull and brain are relatively homogeneous in their resistance, and because this resistance is high an adequate level of stun voltage must be applied. This will ensure that the current flow through the brain, is capable of inducing a stun.

The positioning and configuration of active stun electrodes is crucial of stun efficacy. It is possible to produce a cardiac stoppage and animal paralysis without producing a true stun. Any system of stunning, must be proven to deliver an adequate current flow through the brain before it can be approved for humane use.

Movement control involves both temporal and spatial factors of current flow in the spinal cord. Care is nedded to avoid producing abnormal muscular contractions that can cause damage to valuable cuts. Electrical stunning, both head only and cardiac stoppage, can provide humaneness and movement control, in both sheep and cattle processing, with a greater ease and reliability than other forms of stunning, provided good quality control is practiced.

Handling Problems Caused by Excitable Pigs

T. GRANDIN

Animal Science Department, Colorado State University, Fort Collins, Colorado 80523, USA

During the last four years, increasing problems with extremely excitable pigs have been observe Observations were made in 14 pork slaughter plants located in the U.S.A., Canada, Australia and Denmark. Se pig farms were visited in the U.S.A., Canada and Australia. Observations in the U.S.A. indicated that on average, pigs reared in the midwest states of Iowa, Illinois, Minnesota and Missouri were less excitable and eas to drive up the stunning race compared to pigs reared in the eastern U.S.A. in Pennsylvania and Virginia. So groups of Australian and Canadian pigs were very difficult to drive. The following behavioral problems we observed: 1) Hyper-reactivity and squeal when touched, 2) Extreme flocking instinct (one pig will not separa from the group and move up the race) and 3) Constant backing up in the single file race to the stunner. excitable pig problem is caused by an interaction of three factors: genetics, type of flooring and environmen stimulation. Some genetic lines of pigs are more excitable than others. The most excitable pigs are usually la and often have heavy muscling. Pigs fattened to final slaughter weight on concrete or concrete slatted floors we easier to drive than pigs fattened on plastic or metal floors. A lack of environmental stimulation in some to confinement buildings also contributed to the excitability problem. The pigs that were the hardest to dri usually had a combination of two of the above factors. For example, excitable genetics plus being reared in to darkness. Producers need to select for a calm temperament and provide more stimulation. Reducing excitabili will help reduce losses from PSE.

INCIDENCE OF pH_1 <6,00 IN THE Mm. longissimus thoracis et lumborum OF PIG CARCASES IN SOUTH AFRICA

P.H. HEINZE, J.F.G. KLINGBIEL* & J.D. SNYMAN

ADSRI, Private Bag X2, Irene, 1675 South Africa, *Meat Board, PO Box 40051, 0007 Arcadia, South Africa

The aim of this pH_1 survey (60 minutes post mortem in the *Mm. longissimus thoracis et lumborum*; at the intersection of the thoracic and lumbar regions) was to determine the incidence of pH_1 values <6,00 at seven major pig abattoirs, as this could be used as an indication of the occurrence of PSE in South Africa.

The pH_1 values, fat thicknesses (P_2), carcase masses, sex conditions (boars and gilts/barrows) and producers of 3384 pig carcases were recorded (345 - 700 per abattoir). Five abattoirs were visited on two days, and two on one day. The overall incidence of pH_1 values <6,00 was 21,7 %. Significant differences ($P \leq 0,01$) in the percentage carcases with pH_1 values <6,00 were found between the different abattoirs, ranging from 6,8 % to 54,9 %. At three abattoirs the incidence of pH_1 values <6,00 differed between the two visits ($P \leq 0,05$). Sex condition had no influence on the percentage pH_1 values <6,00 ($P > 0,05$). Fat thickness did not influence the incidence of pH_1 values <6,00 within abattoirs ($P > 0,05$). Differences in the incidence of pH_1 values <6,00 (within abattoirs) of carcases from different producers were also found. Carcase mass did influence the incidence of pH_1 <6,00 values at three abattoirs ($P \leq 0,01$), but on further investigation it was found that these differences were more related to producer differences than carcase mass *per se*.

It is concluded that the incidence of pH_1 values <6,00 is a problem in the South African pig industry, very much related to differences between abattoirs. The reasons for the differences between abattoirs may be due to pre-slaughter animal handling practices or stress susceptibility, or a combination thereof. However, poor animal handling practices prior to slaughter appears to be the more probable cause in light of the 54,9 % incidence of pH_1 values <6,00 at one abattoir against the 6,8 % and 6,9 % at the two abattoirs with the lowest incidence.

Effect of transport on porcine stress

M. HONKAVAARA

Finnish Meat Research Centre, Box 56, SF-13101 Hämeenlinna, Finland

The present study evaluated the effect of transport on porcine stress by analysing the blood creatine kinase (CK) activity at farm and after transport. Furthermore air temperature and circulation (m/s) were measured in a test truck during pig transportation.

Pigs were stressed most severely during transport if loaded just before feeding or transported in warm weather (over 10 C). In addition, increased transport time elevated the CK activity from farm up to the abattoir.

In practice, the first pigs were loaded in front of the vehicle which became warmer than the rear. During transport the temperature fall below zero (C) at the rear on small frost (-4 C). Thus external temperature had a more prominent influence than the amount of pigs on the temperature rise of the transport unit.

Driving speed had a significant effect on the air circulation of the transport unit. Increasing driving speed from 50 to 90 km/h would lead to a better air ventillation in the middle of the vehicle, whereas that was poor in the front and poorest at the rear of the transport unit.

2

Obtaining tender meat by rapid chilling of light lamb carcasses

I. JAIME, J.A. BELTRAN, P. CEÑA and P. RONCALES

Dep. Producción Animal y Ciencia de los Alimentos. Facultad de Veterinaria. Universidad de Zaragoza. 50013 Zaragoza. Spain.

Lamb carcasses of animals aged either 2,5-3 months (light) or about 5 months (heavy), were exposed immediately after slaughter to three different refrigeration conditions: 1) rapid chilling (-4°C for 5 h and 0°C until 24 h post-mortem), 2) chilling (0°C throughout) and 3) conventional refrigeration (2°C for 45 min and 4°C until 24 h pm). In all cases carcasses were aged thereafter for seven days at 4°C. Overall tenderness was evaluated on Longissimus dorsi muscle by a semitrained panel at the first and the seventh days of aging.

At the first day of aging the meat of the youngest lambs was more tender for all treatments. Meat from carcasses held under conventional conditions showed at that time the highest tenderness scores. Meat toughness increased with decreasing treatment temperatures, because of cold shortening, even though muscles kept their intact skeletal attachments. After seven days of aging, an increase of meat tenderness was evident, both in light and heavy carcasses. The degree of tenderization was similar for the three different conditions within each type of carcass. The sole exception was that of light lamb carcasses exposed to rapid chilling, in which the rate of temperature decrease during the first few hours post-mortem was the fastest. Following this latter treatment meat underwent the highest softening, reaching tenderness scores similar to those given to the meat from conventionally refrigerated carcasses.

The rapid chilled carcasses showed a slower rate of pH decrease until rigor onset and the highest pH throughout aging. This effect, in addition probably to that of high calcium level released from sarcoplasmic reticulum due to low temperatures, could most likely induce a higher proteolytic activity of calpain.

The Effects of Marbling, Electrical Stimulation and Post-Mortem Aging on the Palatability of Beef Rib Eye Steak

S.D.M. JONES[1], L.E. JEREMIAH[1], A.K.W. TONG[1], S. LUTZ[2] AND W.M. ROBERTSON[1]

[1]Agriculture Canada, Research Station, Lacombe, Alberta, Canada; [2]Alberta Agriculture, Food Processing and Development Centre, Leduc, Alberta, Canada

A total of 456 beef rib eye steaks were obtained from 229 beef sides selected at a commercial slaughter plant to be representative of four different marbling levels (58 traces, 58 slight, 56 small and 57 modest) over a period of 2 days. Half the carcass sides were electrically stimulated for 18 seconds with a 21 volt rectangular wave and a stimulation current of 0.25 amp within 5 minutes of stunning. After selection, a section of the longissimus thoracis between the 10th and 12th ribs was removed and two steaks, each 1.9 cm thick, were cut from each section. One steak from each side was aged for 4 days, while the other was aged for 11 days at 1°C after vacuum packaging. Once the aging period was complete, all steaks were frozen at -30°C for organoleptic evaluation. All steaks were roasted to an internal temperature of 70°C in an electric oven preheated to 177°C. Six cubes from each steak were randomly assigned to a six member trained panel. Samples were evaluated for tenderness, connective tissue, juiciness and flavour intensity using nine point descriptive scales. Marbling had no significant effect on tenderness, but samples from steaks with modest and small levels of marbling were more juicy than samples with traces of marbling. Low voltage electrical stimulation did not significantly ($P > 0.05$) effect any of the palatability traits evaluated. Samples aged for 11 days were rated higher ($P < 0.05$) in tenderness and overall palatability than samples aged for 4 days. Results from this study indicate no interactions among marbling, electrical stimulation and post-mortem aging on the palatability of rib eye steaks and provide confirmation of the importance of post-mortem aging on the tenderness of beef.

The Effect of Blast Chilling on Carcass Weight Changes and Pork Muscle Quality

S.D.M. JONES AND W.M. ROBERTSON

Agriculture Canada, Research Station, Lacombe, Alberta, Canada

The effects of different periods of blast chilling combined with spray chilling were compared with a spray chilling system in relation to carcass shrinkage and measurements of muscle quality in two experiments. In experiment 1, pork carcasses weighing close to 100 kg were allocated to one of four treatments. Treatment 1 involved the chilling of sides at $1^{o}C$ combined with 36 spray chill cycles every 15 minutes lasting 60 seconds and a drying/chilling period of 15 hours. Treatments 2, 3 and 4 consisted of 1, 2 and 3 hour periods of chilling at $-20^{o}C$, followed by the remainder of the spray chill cycle (32, 28 and 24 cycles, respectively) and the same drying/chilling period. Experiment 2 followed the same design as experiment 1, except that the blast chilling temperature was $-40^{o}C$. In experiment 1, carcass shrinkage measured at 24 hours post-slaughter was similar ($P > 0.05$) for all treatments and ranged from 0.5-0.7 g $100g^{-1}$. No consistent differences in muscle colour, drip loss, shear or sarcomere length were found among treatments. In experiment 2, treatment 4 sides had an average weight gain of 0.4 g $100g^{-1}$ which was different to all other treatments where the weight loss ranged from 0.2-0.4 g $100g^{-1}$. As found in experiment 1, there were few indications that muscle quality was influenced by blast chilling carcasses at $-40^{o}C$. Sides blast chilled for 3 hours at $-40^{o}C$ had darker coloured muscles than sides that were only spray chilled. It was concluded in the majority of cases that spray chilling controlled carcass shrinkage with a similar effectiveness to blast chilling and few consistent differences in muscle quality were observed, except with the most extreme treatment (3 hours of chilling at $-40^{o}C$).

The locomotion behaviour of slaughter pig groups passing a Hoenderken-single-file race of different lenght or width

MARTINA KLEIBS, R.-B. LAUBE

University Leipzig, Dept. of Domestic Animal Genetics, Fakulty of Agricultural Science, Fichtestr. 28, O-7030 Leipzig, Germany

LORE SCHÖBERLEIN

Schlacht- und Verarbeitungs-GmbH Leipzig, Dept. of Research and Development, O-7030 Leipzig, Germany

The locomotion behaviour of groups of 10 slaughter pigs driven without touch through a Hoenderken-single-file race (H.-s.-f. race) with a following left turn was investigated. Three variants of H.-s.-f. race were distinguished.

The aim of this study was to examinate social groups of different number in its passage frequency, the position of the pigs at the race end, the passing time of different animals and the group through the single-file sections and the race at all as well as the passage refusal behaviour. The passing times of the pigs showed strong deviations. In each of the three variants there were passing groups of 1 to 10 animals. Only about 50 % of the pigs passed the single-file race. The passage refusal behaviour of the whole group occured most frequently in all variants. Wide driving ways had a favourable influence on the locomotion behaviour of the pigs, but they caused stoppages, when entering the single-file race. Narrow driving ways to the races had a guiding function. Long final sections (> 4 m) tempted the pigs to enter the single-file race. The average number of the passing group amounted to about 5 pigs.

The results of these experiments show that the function principle of the H.-s.-f. race under the given driving mode must be called in question because it is impossible to separate pigs in motion.

These results could be supported by experiments examinating the function principle of H.-s.-f. races under practical conditions.

There are made proposals to improve the existing single-file races.

2

Stunning of pigs with a high pressure waterjet

E. LAMBOOIJ

Research Institute for Animal Production, Zeist, The Netherlands

Currently available stunning methods do have disadvantages both from the welfare and meat quality point of view. Recently an apparatus which can produce a high pressure waterjet (1000 bar; 17 l/min.) became available. The waterjet allow cutting and drilling through solid materials. Pilot experiments were conducted to examine the potential for use as a stunning method in slaughter pigs.

In 3 heads of just slaughtered pigs a special designed nozzle was positioned frontally (nr 1 and 2) on the head and at 10 cm distance (nr 3). The waterjet was applied during 3, 1 and 1 s, respectively. In all heads the diameter of the drilled hole was <0.5 mm while the dura mater was not visually damaged. Videoanalysis showed that the time to drill through the skin and skull was about 0.2 to 0.4 s.

The method was also applied in 10 slaughter pigs. Judged from EEG all pigs were stunned immedeately after application of the waterjet during 1 s. In some cases the waterjet pushed the head forward during the initial 0.1 s of application. Seven pigs were full relaxed after treatment, while 2 pigs showed weak and 1 pig few strong convulsions. In 2 out of 20 shoulders a minimal blood splash was observed the day after slaughter. It is suggested that the high pressure waterjet cut and drill through the skin and skull and spread over the dura mater afterwards. Consequently a high pressure is built up over the whole brain causing unconsciousness and sometimes a few weak convulsions. The experiments show that it may be possible to develop the high pressure waterjet injection for application as a stunning method in slaughter pigs.

Structural Changes during Postmortem Tenderization of Hot Deboned and Electrical Stimulated Bovine Muscles

M. PETROVIĆ, B. ŽLENDER, LJILJANA PETROVIĆ and J. MILIN

Tehnološki fakultet, 21000 Novi Sad, Bul. AVNOJ-a 1

Effect of electrical stimulation on the structural changes and condition of myofibrillar proteins from hot deboned bovine muscles was investigated during postmortal aging.

Three muscless were excised from both halves of the warm carcasses, 1^h p.m.; M. longissimus dorsi (MD), M. biceps femoris (BF) and M. semimembranosus (SM). Muscles from left halves were used for control. Both groups of muscles were cut into 4 pieces, wrapped in PVC foil and aged at 0^oC. Tenderness - sensory and instrumentally, solubility of total proteins and NH_2-N content were determined in all muscles. The content of free amino-acids and the ulstrustructure changes were determined only in SM: 1, 8, 21 and 42 days after aging.

The obtained results show that ES prevents cold shortening in LD and SM, while in BF it was not estimated neither in NS muscles. The tenderness of NS muscles reached in the period from the 21st to 42nd day, was achieved in ES muscles in the period from the 8th til 21st day.

The increase of tenderness during the whole period of aging was followed by protein solubility increase til the 8th i.d. 21st day, and after that by decrease in both groups. In the same time, the cross-striation in ES muscles disappeared, and in NS muscles the zigzag form of the Z-membrane was observed.

Edible Surface coatings for the Reduction of Weight Losses from Carcasses and Cuts - 2

V.H. POWELL and J. STARK

CSIRO Division of Food Processing, Meat Research Laboratory, Cannon Hill, 4170, Australia

Hot dry carcasses on completion of a 20 hr chill, even under carefully controlled conditions, lose from 1 - 3% of carcass weight due to evaporation. A 2% weight loss represents a loss of $A60 million to the Australian meat industry.

Carcasses treated with a 0.5% emulsion of glycerol monostearate (GMS) were shown to have lower weight losses, brighter colours of lean and fat tissues, and softer, more pliable surfaces than the untreated ones, through seven days post-mortem. Microbial growth on the surfaces of the treated carcasses was greater than that of the control carcasses. The addition of 0.5% acetic acid to the GMS emulsion resulted in no significant differences for bacterial growth between the treated and control carcasses. The GMS film did not affect the aroma, flavour or overall acceptability for lamb. A significant reduction in weight loss for beef, lamb, calf and pig carcasses resulted from the application of such a treatment.

Applicability of skatole measurement in boar fat as a rapid methode in the slaughtering procedure

A. STOLLE and H. SEDLMEIER

Institute of Hygiene and Technology of Food of Animal Origin (Chair: Prof. Dr. A. Stolle), University of Munich, Faculty of Veterinary Medicine, D-8000 Munich, Germany

According to German Meat Hygiene Regulations it is obligatory to test boar meat, if by means of a sensory test a taint in the fat is detected. This procedure is very unreliable, as many people are unable to identify the characteristic odour of its main compound - androstenone.

A Danish research group reported that they have developed a fully automatic, spectrophotometric procedure to measure skatole in extracts of backfat quickly and reliably.

The method has been proven under practical conditions. The reliability of skatole as a guide substance for the evaluation of boar taint was not included in this research work.

The procedure is based on the measurement of a colour complex by a flowcell of 50 mm in the LAMBDA 2-spektrophotometer (PERKIN-ELMER).

The skatole content in 59 samples of backfat was between 0,05 and 0,86 ppm. The limiting value for samples containing boar taint was fixed at 0,25 ppm by the Danish group. In our investigations 12 values were therefore above the declared limit. In a sensory test we could identify at least one boar taint in samples with the highest skatol contents.

The method proved to be quick and reliable for tracing the skatole content.

Antemortem Stress and Chicken Broiler Meat Quality.

T.G. UIJTTENBOOGAART, F.J.G. SCHREURS AND D.L. FLETCHER [1])

Spelderholt Centre for Poultry Research and the Information Services, Agricultural Research Service (DLO), NL 7361 DA Beekberge The Netherlands

[1])Department of Poultry Science, University of Georgia, Athens GA 30602, USA

Effects of ante-mortem stress, chemically generated by subcutaneous injections of epinephrine, on post-mortem broiler muscle physiolo and subsequent meat quality were studied. Also the effects of long and short term natural stress on meat quality characteristics have be evaluated.

Blood lactate and glucose levels have been measured as well as tissue lactate, glycogen and glucose at time of slaughter and 24 hou post-mortem. The color (e.g. L*, a* and b* values) and hemoglobin/myoglobin contents of the raw meat have been estimated.

Injections of epinephrine resulted in higher terminal muscle pH in birds killed 4 to 16 hours post injection. Also these birds show significantly darker breast meat (lower L* values).

Results of the long and short term stress experiment indicated only some minor effects on meat quality characteristics.

A note on the influence of ambient temperature at slaughter on pig meat quality

P.D. WARRISS

Department of Meat Animal Science, University of Bristol, Langford, Bristol BS18 7DY, United Kingdom

The relationship between ambient temperature on the day of slaughter and pig meat quality was examined using information collected from an experiment in which pigs were transported and kept in lairage under very good conditions. A total of 320 male and female LW x (LW x LR) pigs (89 kg) were used. They were obtained in ten batches of 32 animals 7 to 14 days prior to the experimental handling. During this time, and during preslaughter handling, they were not allowed to mix with unfamiliar animals. Transport was for 2h (80km) using only a single deck of the transporter, and loading and unloading were carried out without the use of goads. Stocking density was 0.52 m^2 per 100kg. On arrival at the slaughterhouse the pigs were killed after various times in lairage ranging up to 21h. These times wer balanced within batches and for the present purpose the data for all 32 pigs in a batch were pooled.

Ambient temperature ranged from 12.3 to 23.9°C. Batches of pigs killed when the temperature was higher produced carcasses in whic *m.longissimus* (LD) initial temperature was higher ($r = 0.94^{***}$), ultimate pH was lower ($r = -0.89^{***}$) and water holding capacity was reduced ($r = 0.81^{**}$). The muscles tended to be paler and have higher hue values. Cooked meat from pigs killed at higher temperatures tended to be slightly tougher when measured instrumentally and be rated by a taste panel less juicy and to have poorer flavour than those killed at lower ambient temperatures. There was no difference in panel-assessed tenderness but overall acceptability was significantly lowe ($r = -0.76^{*}$) for meat from pigs slaughtered in hotter weather. The conclusion is that pigs killed when it is cooler have better meat quality than those killed in hotter weather even under conditions of very good preslaughter handling.

Present Situation and Prospects of Meat Refrigeration Technology in China

YANG YAO-HUAN

Department of Food Engineering, Hangzhou Institute of Commerce, China

The paper consists of two parts. The first part introduces the developing course of basic equipment for meat refrigeration, i.e. cold storages which have increased from 38,000 tons capacity at the foundation of P. R. China to present 2,400,000 tons capacity, and describes in detail the distribution of the cold storages for meat refrigeration, the daily animal slaughtering capacity, the situation of meat refrigertaion, ice making and storage, freezing equipment and special transportation lines. The second part deals with the meat refrigeration technology in China according to the demands of consumers and markets for frozen meat and packets of cut frozen meat. In the end it describes the developmental tendency of meat refrigeration technology in the future.