

## SESSION 3. SLAUGHTER

### 3:1

#### HIGH SPEED DOUBLE RAIL RESTRAINER FOR STUNNING OR RITUAL SLAUGHTER

Grandin, T.

Department of Animal Science, University of Illinois, 1207 West Gregory Drive, Urbana, Illinois, 61801, USA

The objective of this project was to develop an improved conveyor restrainer system for holding calves and sheep. V conveyor restrainers work poorly for small calves because the animals cross their legs and sometimes fall through the bottom of the restrainer. Some animals also have difficulty entering the V restrainer.

A double rail conveyor restrainer system was developed and installed in a commercial slaughter plant which processes calves and sheep. Calf weights varied from 23 kg to 226 kg. The line speed in the plant was 150 to 300 per hour. Animals enter the restrainer and straddle two moving rails. They are supported on their belly and brisket. The dimensions of the two moving rails are 70mm high by 110mm wide with a 70mm space in between them. The two rails are constructed from metal segments on a single conveyor. The animals are supported upright on the double rail conveyor by solid adjustable side panels. Stunning is conducted while the animal is held on the double rail. Ritual slaughter is conducted by stopping the double rail conveyor for the throat cut. After the cut, the animal is ejected onto a flat moving table conveyor. The shackle is attached while the animal is held on the double rail.

Observations of this system for over six months indicate that it has many advantages compared to a V restrainer conveyor.

### 3:2

#### EFFECT OF PRE-SLAUGHTER HOLDING TIME ON PORK YIELDS AND QUALITY

A.M. González, O. Venegas & L. Bencomo

Meat Division, Food Industry Research Institute, Carr. Rancho Boyeros, km 3 ½, Havana 8, Cuba

#### OBJECTIVE

The objective of this paper is to determine the influence of pre-slaughter holding time on the carcass and boned meat yields and the quality of pork from a commercial breed of Landrace Yorkshire X Duroc Jersey pigs.

#### EXPERIMENTAL

Pigs were slaughtered 2; 24; 48; 72 and 96 hours after arriving to the slaughterhouse. They were fasted during all of the pre-slaughter holding time.

Carcass and liver weights were recorded, as well as the total weight of meat and fat obtained in boning. Yields were calculated on the basis of the weight at arrival.

pH<sub>1</sub>; pH<sub>2</sub>; WHC (expressed both as M/F ratio and as percentage of total water); Hunter's lightness L and the Fiber Optics Probe (FOP) value were measured as pork quality indexes.

#### RESULTS AND CONCLUSIONS

Warm carcass yields of pigs slaughtered 2 hours after arrival was 1.4 % higher than that of pigs slaughtered after 24 hours holding. After that time, warm carcass yields diminished a further 0.5 % for every 24 hours additional holding. This affected boned meat yields, which were ca. 2 % lower after 72 hours fasting.

1. Stunning is easier and more accurate because the operator can stand closer to the animal. The distance is 400 to 430mm in a V restrainer compared to 70 to 180mm in a double rail restrainer. A heavy pneumatic stun gun can be easily used without a balancer in the double rail.

2. Animals enter with less balking and ride more quietly. Less than 1% of formula fed veal calves attempted to climb on the back of the animal in front of them while riding the full length of the 5.48m double rail conveyor. There were no hold down bars over the animal's backs.

3. The double rail restrainer can be adjusted for animals varying in weight from 14 kg to 226 kg within 15 seconds by moving the solid side panels. The simple adjustment mechanism does not require pneumatic, hydraulic or electrical devices.

4. Shackling the animal in the double rail is easier compared to a V restrainer because the legs are separated.

5. The double rail restrainer is less expensive than a V restrainer because it consists of only one conveyor instead of two.

In conclusion: For calves the double rail restrainer is a superior system compared to the V restrainer. The system also worked well for sheep. The use of the double rail restrainer should also be investigated for pigs and adult cattle.

Losses in liver weight and yield were large during the first 48 hours, but there were no significant further losses after that time.

Mean values of the quality indexes measured were within normal range. pH<sub>1</sub> varied between 6.3 and 6.5 and pH<sub>2</sub> between 5.5 and 5.6 for all holding times. WHC was rather low in all cases, but increased gradually from 0.22 to 0.29 with increasing holding time. Hunter L values ranged from 48 to 45 and FOP values from 153 to 144, respectively, for holding times from 2 to 96 hours.

Only two carcasses presented PSE meat, one after 24 hours and one after 48 hours holding, whereas two of the pigs slaughtered after 96 hours holding gave DFD meat.

Even though quality did not seem to be significantly affected by the prolonged fasting times, quantitative results stress the convenience of keeping pre-slaughter holding times at a minimum.

### 3:3

#### TRANSIENT NEOCORTICAL AND HIPPOCAMPAL EEG SILENCE INDUCED BY ONE MINUTE INHALATION OF HIGH CONCENTRATION CO<sub>2</sub> IN SWINE

A. FORSLID

Swedish Meat Research Institute, Kävlinge, Dept. of Physiology, Faculty of Veterinary Medicine, Swedish University of Agricultural Sciences, Uppsala, and Dept. of Clinical Neurophysiology, University Hospital, Lund, Sweden

About 1 min exposure to CO<sub>2</sub> is today commonly used as pre-slaughter anaesthesia. In recent years the ethical aspects on this method have been debated. This discussion has revealed a lack of basic knowledge regarding the effects of high concentration of CO<sub>2</sub> upon the central nervous system. Therefore a project was started, with the aim to elucidate the neurophysiological effects of one min inhalation of high concentration CO<sub>2</sub> in the swine.

As a first step in a series of investigations the principal effects of 80% CO<sub>2</sub> inhalation on rats were studied. Parameters as electroencephalogram (EEG), and sensory evoked responses were followed (1). The second step was the development of a technique for implantation of permanent electrodes in different brain structures and the registration of the normal EEG activity from these regions in the awake unrestrained swine (2). In the present study (3) six Yorkshire swine were used. Steel electrodes, with un-isolated tips, were implanted into the neocortex, dorsal parts of the hippocampus, and the amygdaloid nuclear complex. The implantation was performed under surgical anaesthesia. About one week after the implantation the swine were exposed twice to 80% CO<sub>2</sub> for one min. The EEG was recorded before, during, and after the exposures. In five of the animals myoclonic jerks started at 28±1 s of exposure and lasted for 6±2 s. Neocortical slow

wave (delta) activity and increased amplitude of the hippocampal theta (5-7 Hz) waves (i.e. EEG changes seen during the 2nd stage of barbiturate anaesthesia) had developed a few seconds before the brief period of myoclonic jerks. After this period the EEG activity gradually declined, resulting in neocortical EEG silence at the end of exposure. This apparent iso-electricity lasted for, on the average, one min. The return of the neocortical activity exhibited a pattern reverse to its disappearance, but was much prolonged in comparison to the EEG extinction. Pre-exposure neocortical EEG pattern was not regained until 3 to 5 min post exposure. In 8 of 11 experiments the CO<sub>2</sub> inhalation also induced hippocampal EEG silence lasting for, on the average, half a minute. EEG flattening was also obtained when recording from amygdaloid nuclear complex and from adjacent pyriform cortex. The observed changes in the neocortical and hippocampal EEG suggest that the present swine were unconscious already when they exhibited motor reactions. This does not exclude that CO<sub>2</sub>-independent stress/arousal factors present in a slaughterhouse environment may facilitate the development of motor phenomena similar to seizures, with the result that such reactions become manifest before the neocortical EEG exhibits an anaesthesia pattern. The duration of the observed EEG silence implies that, from the ethical point of view, exsanguination might safely be performed within one min after the moment when the animal is removed from the high concentration CO<sub>2</sub>. However, the slow return to a pre-exposure neocortical EEG pattern suggests that the consciousness of the swine remains blunted for at least another minute.

#### References

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### 3:4

#### THE PROBLEM OF DARK-CUTTING IN VEAL

Malmfors, G. & Brendov, B.

*Division of Meat Research, Department of Animal Breeding, The Swedish University of Agricultural Sciences, S-750 07 Uppsala, Sweden*

The problem of dark-cutting in beef has recently been studied in detail but there are few published investigations concerning DFD in veal.

In Sweden, the DFD frequency for young bulls has decreased over the last 3-4 years, thanks to the application of special handling recommendations at slaughter. Unfortunately, such recommendations regarding calves (carcass weight 100-110 kg) have not yet been in force for more than a couple of years and the DFD frequency is therefore still high, approx. 15%. Since the production of veal in Sweden is quite substantial (10 Mkg in 1985) DFD in veal is responsible for a considerable depreciation in carcass value for the meat industry.

During recent years, investigations have been performed at the Meat Research Division with the object of studying the effect of handling procedures for calves at the abattoir. Effects on ultimate pH values of group size, lairage time and a low ceiling in the lairage to prevent mounting have been studied. Different group sizes, with 4-5, 8-10 and 16-20 calves, were used. Each group was laired for 1-2, 4-5 hours and overnight. The carcasses were electrically stimulated during the bleeding phase. The ultimate pH was measured in several muscles.

The main results:

- Ultimate pH was influenced by group size and lairage time. Placing calves in medium or large groups for longer periods, especially overnight, caused a dramatic increase in pH. However, for the animals in small groups, the pH value did not differ significantly with varying lairage time.
- Ultimate pH was also affected by the handling routines on the farm.
- Bull calves had higher ultimate pH than wye calves.
- Ultimate pH varied between and within muscles. *M. longissimus dorsi* and *M. semitendinosus* had the highest mean values and *M. psoas major* and *M. quadriceps femoris* had the lowest.
- The use of a low ceiling in the lairage to prevent mounting reduced the ultimate pH.

A few significant conclusions:

- The holding period in the lairage should be kept as short as possible.
- No more than 4-5 calves should be housed in a pen, especially if they are to be laired overnight.
- Attempts to mount were prevented by lowering the ceiling in the lairage.

## DETERMINATION OF MATURITY IN CULLED COWS

Klastrup, Signe &amp; Sørensen, S.E.

Danish Meat Research Institute, Maglegårdsvej 2, DK-4000 Roskilde, Denmark

Determination of the age and maturity of beef carcasses is important in relation to meat quality; especially tenderness. The main reason for this is believed to be the development of toughness in the intramuscular connective tissue with increasing age.

It is probable, however, that this development in meat quality is more closely connected to general physiological development of the carcass (maturity) than the chronological age of the animal.

The objective of this study was to examine different methods for determination of maturity and age in culled cows and to investigate the relationship between maturity and meat quality characteristics.

The investigation included a total of 90 Danish Friesian (SDM) cows ranging in age from 24 to 105 months. The animals were distributed on three feeding regimens during lactation and were slaughtered 1 to 37 weeks after calving. The cows were slaughtered and chilled according to the Institute's standard procedures.

The evaluation of age and maturity was carried out by the following methods:

1. Determination of number of permanent incisors.
2. Assessment of ossification of the sacrum, sternum, praesternum (manubrium sterni) and thoracic process cartilage.

## 3:6

## DECOLORATION OF BLOOD BY HEM OXIDATION

Wismer-Pedersen, J.

Institute of Meat Technology and Process Engineering, Royal Vet.- &amp; Agricultural University, DK-2000 Frederiksberg, Denmark.

Full use of blood proteins as ingredient in food products usually requires decoloration of hemoglobin which constitutes about 70% of the total blood proteins. Decoloration may be affected by removal of the hem group from globin or by destruction of the porphyrin ring. A method to decolorize hemoglobin with erythrocytes as raw material is described. The method combines removal of liberated hem with oxidative destruction of remaining hem in globin. Oxidation by hydrogen peroxide destroys the porphyrin ring. When erythrocytes are used as raw material inhibition of their catalase activity is a prerequisite. The catalase activity was inhibited by adjusting an erythrocyte suspension to pH 2.5, which denatures the hem proteins. Polymerized hem liberated from the proteins, and cell debris were removed by centrifugation at 18000 G for 20 minutes. The pH of the supernatant was adjusted to pH 4 and hydrogen peroxide added to a concentration of 0.1 - 0.4%. The reaction is highly temperature dependent and proceeds very slowly at low temperatures. The preferred reaction temperature is 20-25°C which gives a reaction time of 20 - 24 hours. The process was monitored from absorbance spectra. After exposure to pH 2.5 the hemoglobin showed a soret peak at 395 nm and a single peak at 275 nm. After reaction with hydrogen peroxide the soret peak completely disappeared and the spectrum was quite nondescript with a broad shoulder at 260-280 nm. After H<sub>2</sub>O<sub>2</sub> treatment the globin was tasteless, highly soluble at pH below 5 and produced viscose, gel-like solutions on heating

3. The chronological age of the animals was recorded.

The determination of meat quality included lightness (Hunterlab), percent intramuscular fat, and shear force measurements on Longissimus Dorsi.

For animals of less than about 3½ years the number of permanent incisors were useful as predictor of the chronological age. However, the usefulness of this method is limited in practice as the head is removed from the carcass at an early stage during slaughtering.

The relationship between chronological age and the degree of ossification was quite strong for the thoracic process cartilage ( $r = 0.82-0.84$ ) and also significant for the sacrum, sternum and praesternum ( $r = 0.52-0.64$ ).

Only poor relationships were found between the meat quality characteristics and the degree of ossification or chronological age.

It is concluded that the assessment of maturity as carried out in the EEC-EUROP-system result in a good description of the chronological age of the animal.

For establishing the relationship between the maturity and meat tenderness, however, more direct measurements of connective tissue toughness should be carried out.

to 80°C. The remaining hydrogen peroxide can be removed by addition of ascorbic acid and the globin was isolated at pH 5 by freeze drying.

The decoloration method is inexpensive and results in a product which might be useful to increase the protein content of food products.

### 3:7

#### TEXTURIZATION OF PROTEIN RECOVERED FROM BLOOD PLASMA

A.A. Dias Correia  
Universidade Técnica de Lisboa  
Lab.de Bioquímica - Escola Superior de Medicina Veterinária  
R.Gomes Freire - 1199 Lisboa Codex - Portugal

**AIMS** We intended to get texturized protein tapes from bovine blood plasma mixed with different types of polyssacharides, so that they could be consumed directly (resembling meat slices) or otherwise mixed in hamburgers, sausages or other products.

The viability of getting texturized tapes (45 mm wide; 0.3mm thick) was investigated.

**EXPERIMENTAL METHODS** Collection and separation of beef blood plasma - Blood from beef animals was obtained in a local slaughterhouse. A 10% (w/v) sodium citrate solution was added to the blood, at a concentration of 10% (w/v), to prevent coagulation.

The red cells were discarded at 1000 g for 15 min.. Spinning of protein tapes - Plasma was mixed 2% sodium alginate (pronalgina KV - Alginates Y Coloides - Tuy - Pontevedra - Spain) or other polyssacharides, and homogenized with an Ultra-Turrax at maximum velocity for 5 min. with subsequent centrifugation at 1000 g for 30 min.. The spinning dope was extruded with compressed air through a stainless steel spinneret, provided with a slit 45 mm x 0,3mm, into a coagulation bath at pH 2.00 and room temperature, which contained a solution of 18,6% acetic acid with 5% of calcium chloride, or other acids, or flavouring substances.

**MAIN RESULTS** We got tapes of texturized protein using sodium alginate as a thickening agent for the plasma and receiving it in a coagulating bath pH 2.00 consisting of acetic acid and 5% CaCl<sub>2</sub>. The utilization of different types of polyssacharides, different coagulating baths, and the mixture of the plasma with a variety of flavouring substances prejudicated the keeping quality and texture of the product. The same applies to the coagulating baths when they carry the flavouring substances.

After the tapes leave the spinneret and deep into the coagulating bath they reduce their width to one half and become thicker. Microbial analysis revealed very low microbial load (< 10<sup>2</sup> per gram) and the keeping quality of the products at room temperature was above one year, either when stored without cover or inside plastic bags.

On the day they are produced, the tapes contain 10% protein (on a wet basis) and this value is increased to 50% after drying at room temperature for a fortnight. The digestibility coefficient was 92,6 to 94, % (Pepsin 24 or 48h) and 47, % to 57,9% (KCl 24 or 48h) and the composition in amino acids close to the one from plasma protein. The texture of the tapes was close to meat products, though its taste was slightly acidulated and with a "background flavours" recalling alginates.

**CONCLUSIONS** Starting with blood plasma it is possible to obtain texturized products with a high nutritional value and strong keeping powder at room temperature. Subsequent studies investigating the viability of an industrialization of the process are fully justified.

### 3:8

#### IMPROVED METHOD FOR ELECTRICAL STIMULATION OF BEEF AND SHEEP CARCASSES

D.Tsankov, I.Maslinkov, G.Mihov  
Higher Institute of Food & Flavour Industries  
Plovdiv, Bulgaria

It is world wide practice to fix the voltage magnitude when stimulating animal carcasses but from physiological point of view the response of the carcass is not closely related to the voltage applied but to the current density (to the magnitude of the electric current through the carcass respectively). When stimulating at fixed voltage values the current through the carcass changes depending on the impedance of the carcass as well as on a number of uncontrolled factors: contact resistance between railway and shackle, and between electrodes and carcass; size, shape and location of electrodes; polarization phenomena etc. These factors are essential for low voltage electrical stimulation. That is why conditions of stimulation differ significantly for each separate animal even if electrical stimulation is carried out at one and the same voltage.

The method that we suggest eliminates some of these problems because during stimulation the magnitude of the current is automatically kept constant.

Experiments were made using a specially designed unit with the following parameters of electric current: unipolar square pulses with amplitude up to 0.5 A; pulse duration 1-20 ms; interval between pulses 10-100 ms. The railway served as the negative electrode in both cases; when stimulating beef carcasses the positive electrode was a nose-clamp and for sheep a three-point electrode inserted in the neck muscles was used.

The maximum impedance between electrodes depends on the chosen value of electric current and the maximum allowable voltage that depends on the safety voltage regulations of each country.

Our results concerning  $\Delta pH$  were good, had good reproducibility and confirmed the advantages of the method. That is why we recommend its application for industrial and research purposes.

EFFECT OF LOW VOLTAGE ELECTRIC STIMULATION  
ON THE HYDROPHILIC AND ORGANOLEPTIC PROPERTIES OF BEEF

Kostov, A.<sup>1</sup>, Vhulkova, K.<sup>2</sup>, Danchev, S.<sup>2</sup>

<sup>1</sup>Meat packing-house, Sofia, Bulgaria

<sup>2</sup>Higher Institute of Food Industry, Plovdiv, Bulgaria

Electric stimulation (ES) of animal carcasses is a technological method of enhancing pH drop and the process of rigor mortis. Post-mortem changes in the hydration ability of muscle tissue are of great importance for meat processing and an important factor for the quality of the final meat products.

The effect of low voltage ES on the hydrophilic properties of cattle-beef was studied. Calves of the "Black-motley" breed 20 months of age and with 440±40 kg live weights were electrically stimulated immediately after slaughter and bleeding with square monopolar pulses of 10 ms duration, 14,3 Hz frequency and 90 V amplitude. The time of ES was 2 minutes.

Following ES the test samples and controls were fast chilled at -10±-15 °C, air velocity 2-3 m/s, to a temperature of +6 °C (in depth) and stored at an ambient temperature of 0 °C to 2 °C.

The effect of ES on the water-holding capacity of muscle tissue from cattle was determined through determination of water losses during storage and heat-processing.

From the results obtained we found that ES does not influence the amount of water separated during storage at low positive temperatures as well as during heat-processing performed after the first 24 hours.

Organoleptic assessment indicated that the overall organoleptic acceptability of ES samples is significantly higher already on the 7th day compared to the non-stimulated controls. This advantage derives mainly from the differences in tenderness, while the rest of the characteristics-colour, juiciness, flavour-have the same or slightly higher values for the ES samples.

THE ELECTRICAL STUNNING OF PIGS

observations, current flow, stunning degree

R. Wyss municipal slaughterhouse Biel-Bienne Switzerland

The execution of electrical stunning of pigs gives rise to objection to insufficient observance of the law about animal welfare.

An inquiry at different slaughterhouses results in using many different utensils to stun the pigs and different methods of stunning. The observation shows us inadequate driving of the animals to the place they will be stunned, the stunning material in bad conditions, deficient stunning technique and too much time from stunning to bleeding. The investigations resulted in instructions how to improve the situation. The recording of the currents course allows a comparison between the stunning in a system with and a system without fixation of the pigs.

The attainable highest amperevalue was measured at a stunning voltage of 75, 220 and 260 volts.

A stimulus by doing a incision in the skin of the head on the stunned pigs and the following reaction was the only usefull test to ascertain a sufficient stunning degree.

Conclusions

Pigsheds: should be equipped with showers to appease the pigs and to obtain a higher amperevalue (wet skin).

Stunning-tongs: without a switch (a switch disturbs the development of current).

Electrodes: must be sharp and pointed and have to enable to catch the pigs safely.

Position of the electrodes: only on the head to stun the animals. On stunned animals a position head-chest avoids convulsions and makes it easier to place the bleeding-stab.

Stunning-time: at least 10 seconds at 220, 260 and 320 volts.

Minimal voltage: 220 volts. Lower voltage must be forbidden.

High voltage does not guarantee a good stunning.

Time from stunning to bleeding: not more than 30 seconds.

Method to test the stunning: the only usefull test is a incision in the skin of the head and the observation of the following reaction.

### 3:11

#### THERMOGRAPHIC METHOD OF DETERMINATION THE EFFECT OF LOW VOLTAGE ELECTRIC STIMULATION OF SHEEP

Kostov, A., Howary, M., Danchev, S.

Higher Institute of Food Industry, Plovdiv, Bulgaria.

The principal aim of electric stimulation is to enhance the degradation of those substances that act as energy-carriers in muscle tissue (ATP, glycogen, etc.). Since the process of degradation is accompanied by liberation of certain amount of heat, determination of temperature kinetics could possibly serve as an accurate analysis of the results obtained after performing electric stimulation. To ascertain that possibility, Merinofleisch sheep with live weights of 42 to 48 kg were used. After slaughter, the animal carcass was cut into two sides, and one side was stimulated for 2 minutes with square monopolar pulses having 10 ms duration, 14,5 Hz frequency and 90 V amplitude. The temperature change dynamics were determined by a special mea-

suring equipment including personal computer, semi-conductor temperature sensors, 32-bit analog-to-digital converter and respective software (control program and digital filtering program). The system's resolution was 0,001 °C. This measuring system ensured recording data from both channels on a floppy disk, approximation of sensors' indications by a third degree polynomial, and automatic graphic display of the dependance of both temperatures, and their difference, on the cooling time. Temperature differences were followed up to 24 hours post slaughter in 5 min intervals.

The results obtained indicate temperature differences between the two sides, these differences having a clearly marked maximum in the interval 7 to 8 hours post slaughter.

Temperature change was the same with different animals, with stimulated sides cooling faster than the non-stimulated. The absolute value of temperature differences, however, varied in the range of 0,1 °C - 4,5 °C, indicating that electric stimulation affects degradation processes in different animals to a different extent.

### 3:12

#### EVALUATION OF YIELDS OF OFFALS AND SLAUGHTER BYPRODUCTS IN YOUNG FATTENING BULLS OF DIFFERENT GENOTYPE

Szücs, E.<sup>1</sup> <sup>2</sup> Ács, I.<sup>1</sup> - Csiba, A.<sup>2</sup> - Tobiás, Zs.<sup>2</sup>

<sup>1</sup>Research Centre for Animal Breeding and Nutrition H-2101 Gödöllő, P.O. Box 57, Hungary

<sup>2</sup>Hungarian Meat Research Institute, H-1097 Budapest, Gubacsi út 6/b. Hungary

In a series of experiment Hungarian Red Spotted /HRS/, Holstein-Friesian /HF/, Hungarian Grey /HG/, and Hereford /HE/ young fattening bulls were slaughtered at 200, 350 and 500 days of age. Preslaughter weights for the genotypes given were 180, 354 and 513; 255, 377 and 504; 160, 266 and 402, as well as 108, 264 and 395 kg, respectively.

Yield of offals, weight of organs, fat around the digestive system and perinephric fat was recorded. Findings were evaluated by analysis of variance according to a 4x3 factorial design. Tendencies for development of internal organs, i.e. offals and slaughter byproducts during the growing-finishing period could be established.

At slaughter highest ratio of total fat was recorded in HF young bulls at the age categories determined /50.8, 47.0 and 48.8 percent/ and lowest ones in their HE counterparts /30.7, 30.8 and 37.3 percent, respectively/. Intermediate yields of fat

were found in HRS and HG young bulls, first of all at the final phase of fattening. This phenomenon may be in relation with the dairy, beef or dual purpose character of breeds investigated. Relative values for the percentage of preslaughter weights seemed to decrease with advancing age in all offal categories /internal organs/ but skin. Mean values for head with brain, lung, liver, spleen, heart, kidneys, tripe, small intestines and large intestines were in HRS, HF, HG and HE 2.8, 2.6, 2.9 and 2.5; 0.48, 0.52, 0.42 and 0.62; 1.24, 1.51, 1.44 and 1.30; 1.03, 1.09, 1.16 and 1.00; 0.21, 0.16, 0.18 and 0.16; 0.39, 0.39, 0.38 and 0.34; 0.19, 0.22, 0.21 and 0.18; 1.7, 1.8, 1.6 and 1.8; 1.0, 1.9, 1.1 and 1.0; 0.7, 0.8, 0.6 and 0.8 per cent at 500 days of age, respectively.

3:13

#### THE OCCURENCE AND RAPID IDENTIFICATION OF DFD OF BULLS

A. MIKULÍK<sup>1</sup>, J. BÍBOVÁ<sup>2</sup>, D. ZEMANOVA<sup>3</sup>,  
- Z. DVORÁK<sup>3</sup>

Department of Food Hygiene and Technology,  
University of Veterinary Medicine, 612 42  
Brno, Czechoslovakia

Municipal Veterinary Hygienic Centre,  
300 00 Plzen, Czechoslovakia

Meat Industry Research Institute, 612 00  
Brno, Czechoslovakia

The occurrence of DFD in bulls was evaluated by measuring  $pH_{24}$  with a portable transistor digital pH-meter DIGI 88/WTW, and spear-tip glass electrode. The measurements were made in MLLT, on the level between 8th and 9th rib, 5 cm from the backbone. Meat of bull carcasses with higher  $pH_{24}$  than 6.2 was considered as DFD. From 610 bull carcasses of different breeds and interbreeds, of common reception to the slaughterhouse, 44.09 % were evaluated as DFD. Moreover 1783 bull carcasses were also differentiated. Bulls which were transported and slaughtered the same day of the next day had 2.62 % and 69.03 % DFD, respectively. It was confirmed that keeping bulls loose overnight in the slaughterhouse increases the occurrence of DFD. The influence of the length of transport (up to 30 km and 30-100 km) on DFD occurrence was not ascertained. The influence of the yearly season was not considerable, in a cold season (November-February) the occurrence of DFD was 2.59 %, higher than in warmer

season (April-May). The results confirm the opinion that the DFD of bulls has its origin in the exhausting the energy sources in the skeletal muscle as consequence of its exceeding activity and fatigue due to pre-slaughter stress factors which influence the metabolism, especially in the conditions of keeping bulls loose. For the purpose of rapid identification of DFD at the end of slaughter line electrical low-voltage stimulation (E.S.) by the equipment MITAB was used, performed 10 min. after stunning. E.S. of bull carcasses increased the rates of glycogenolysis and glycolysis in muscle to such an extend that even  $pH_1$  could be used for DFD identification. For evaluating DFD values,  $pH_1$  6.2 or 6.4 after E.S. was used. From statistical evaluation of 90 carcasses it was ascertained that at higher values than  $pH_1$  6.4, 22.8 % carcasses were considered as DFD which were not found DFD by respecting  $pH_{24}$ . At the same time 24.4 % carcasses with DFD escaped the identification. When higher values than  $pH_1$  6.2 after E.S. was used as criterion all carcasses with DFD were identified. But this group included also 39.2 % of the carcasses which are not DFD when evaluated on the basis of  $pH_{24}$ . E.S. appears to be suitable also for rapid identification of DFD under practical conditions in meat plants.

3:14

#### DEVELOPMENTS IN CATTLE CARCASS GRADING

Ender, K.; Große, F.

Research Centre for Animal Production

DDR - 2551 Dummerstorf, German Democratic Republic

The grading of cattle carcasses is necessary on the basis of objective parameters. They have to give a precise prediction of the lean - fat - bone ratio. The carcasses of Black pied Milk Cattle bulls of GDR (SMR) from 200 kg up to 260 kg carcass weight contain about 71 % meat, 19 % bone and 9.5 % edible fat. It has been estimated that the optimal content of edible fat for a good quality should be in the range from 7 % up to 12 %.

The carcass weight is affecting the composition. With increasing carcass weight the fat content also increases and the bone content decreases. Fat is the most variable component. A precise carcass assessment by complete dissection of the slaughtered cattle cannot be done during the slaughtering process in the abattoir. Therefore, certain auxiliary data are used allowing a high degree of conclusiveness for carcass composition, being also readily measurable. Carcass weight alone is too incorrect for the prediction of carcass composition and grading respectively. It must be combined with other parameters.

The kidney fat is related to the fat content with  $r = 0.87$ . Its correlations with the

carcass weight are  $r = 0.88$  for bulls,  $r = 0.87$  for cows and  $r = 0.80$  for heifers. But there is a great range of kidney fat within one carcass weight class. Both, carcass weight and kidney fat are the basic parameters for the grading of cattle carcasses in the GDR.

Bone content (%) also has a high economical importance. Bone % is correlated with head % ( $r = 0.69$ ), feet % ( $r = 0.63$ ) and the carcass length (%) ( $r = 0.74$ ). The kidney fat kg: carcass length cm ratio gives the best information to evaluate the ratio of bone to edible fat with  $r = 0.83$ .

It would be advantageous to have devices for the grading of cattle similar to the already existing devices for pig grading. But so far such instruments are only in the development stage.

### 3:15

THE EFFECTS OF SHORT PERIODS OF WATER AND/OR FEED DEPRIVATION, AND REALIMENTATION, ON THE LIPID CONTENT OF THE M.longissimus dorsi AND THE LIVER OF SHEEP

Shorthose, W.R.

Meat Research Laboratory  
P.O. Box 12, Cannon Hill, Qld 4170, Australia

Sheep sent to slaughter in Australia may be without feed, and sometimes water, for a period of days. All of them are given access to water, but not necessarily feed, before slaughter. There is little information on the effects of these treatments on muscle lipids.

After a 10 week period on a constant diet (80 g/kg<sup>0.7</sup>) of lucerne chaff and oats (50:50) 16 mature sheep (mean final liveweight 42.9±0.5(S.E.) kg), four per group, were subject to periods of water and/or feed deprivation and slaughtered at the laboratory. Group A animals were offered their normal feed until the day of slaughter and had continuous access to water. Group B animals were not fed for three days before slaughter but had access to water. Group C animals were deprived of feed and water for 48 hours, refed 26 hours before slaughter, and allowed access to water until slaughtered. Group D animals were without feed for 3 days before slaughter, and water for the first two of these days, but were allowed access to water on the day prior to slaughter until slaughtered. Groups A and C were last fed 26 hours and groups B and D 74 hours before slaughter.

Samples of the M.longissimus dorsi (LD) and liver were removed and analysed for dry matter (DM) and ether extract (lipid) content by A.O.A.C methods.

As expected, the liver dry matter and liver lipid (ether extract expressed as a percentage of dry matter) were significantly greater in the groups (B and D) deprived of feed for 74 hours rather than 26 hours before slaughter (Groups A and C). However, a similar effect occurred in the muscle, although carcass fat content has been reported to be reduced by feed deprivation of a similar duration. Access to water did not influence these changes significantly. Differences in the extent of lipid accumulation in muscle could influence the ability of animals to withstand other preslaughter stresses.

### 3:16

SHORT-TERM HIDES PRESERVATION USING AIR CHILLING

V.I.IVASHOV, T.V.VERETOVA, D.P.RADKEVITCH\* and O.I.YAKUSHEV\*\*

\*The All-Union Meat Research and Designing Institute, Moscow, USSR

\*\*The Moscow Technological Institute of Meat and Dairy Industries, Moscow, USSR

Studies aimed at the establishment of possibility of short-term hides preservation using atmospheric pressure and vacuum at temperatures close to zero that allow to maintain natural structure of raw materials were made.

Raw materials had higher qualitative characteristics after treatment at 0-5°C. Investigations were done to find out technical and technological parameters of hides chilling in air medium and in vacuum. Physico-chemical, microbiological and histological characteristics of raw materials were analysed; samples of hides treated using chilling were evaluated organoleptically.

At chilled hides storage for 20 days at 5°C it was found that water content decreased by 3.0-4.4%; pH of water extract changed by 13-13.7%; free ammonia content increased from 0.01 to 0.11mg%; hides weight changed from 3.0 to 4.4%; aerobic bacteria content increased from 4.5x10<sup>5</sup> to 1.2x10<sup>6</sup> per 1cm<sup>2</sup> of hide surface; psychrotrophic microorganisms amount increased from 2.5x10<sup>7</sup> to

5.4x10<sup>7</sup> at temperature optimum of their growth being equal to 0-10°C. Organoleptical parameters changed nonsignificantly. Collagen native structure at chilling and storage was more effected by storage period of the treated raw material that was testified by the methods of dispersion and correlation analysis and statistical analysis of the results.

Hystological testing of chilled hides did not show microstructure changes as compared to the microstructure of raw materials. Half-finished leather goods were made from hides chilled at temperatures just above zero; these goods corresponded to standard treatments.

As the result of the studies it was determined that hides chilling allow to preserve hides quality for 7 days; to exclude salt use for preservation; to decrease labour input of raw material treatment; to intensify the process of hides treatment; to save energy and to increase the sanitary level of hides preservation. All these facts testify to the usefulness and efficiency of the developed method.

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3:17 SECTION 4. FRESH MEAT TECHNOLOGY

A STUDY INTO THE RELATION OF CARCASS MEASUREMENTS TO MEAT PRODUCTIVITY OF YOUNG BEEF CATTLE

Yu.V. TATULOV, I.P. NEMTCHINOVA, I.F. SOROKINA and G.P. GOROSHKO

The All-Union Meat Research and Designing Institute, Moscow, USSR

The purpose of this work was to study a possibility of predicting the composition of beef carcasses by the interrelation of the weight of certain parts of a carcass to their measurements.

The authors measured the length, width, round girth, muscle and fat thickness of every side. Sufficiently high correlation coefficients were found among meat and side weights, the distance from withers to the end of the breastbone, round girth, side length. The mathematical processing of the results obtained yielded regression equations which allow to predict the meat productivity of beef cattle and the morphological composition of carcasses without boning.

appear to be under strain. The relationship was noted between the mechanical parameters (resistance and elasticity) determined in raw meat and the collagen content of the different parts of the carcass. The correlation between collagen content and mechanical resistance when the resistance was increased, this correlation reached its highest value under a 20-25% compression. Thus, during descriptive compression tests (20-25%) variations in collagen content explain 25% of the variations in mechanical resistance ( $r = 0.50$ ). The relationship between collagen content and elasticity is, however, not as tight ( $r = 0.30$ ). The correlation coefficient between the linear density of the primary part of the collagen network and collagen content is nearly 0.50. The information on collagen content given by mechanical measurements was not improved when linear density is taken into consideration. No relationship was found between the different mechanical parameters used as one meat and the solubility of collagen, which is an important component of cooked meat tenderness.

Conclusions were supported with a fine dissection of the muscle, perpendicular to the axis of the collagen network. The growth of a branching of the collagen network, at low compressive forces (4-20%), the number of collagen fibers were reduced, but collagen fibers were not really revealed. To characterize the resistance of these fibers, the network has to undergo tensile force. This can be achieved only when compression is beyond 30%, with loss of volume any apparent branching in collagen, but a regular motion under tensile force should be used in this range of compression. The application of such a test to the entire muscle parts with additional problems in connection with apparent weight loss and deformation characteristics.

Results from Study 2 revealed that 0.25 of 0.5% can be successfully incorporated in the formulation of a substrate for beef. Increased freeze time and weight contributed to flavor degradation and increased pH values. This observation was attributed to the failure to incorporate the optimal amount of this potential antioxidant.

These studies supported the conclusion that (1) 0.5% and 0.75% can suppress the stability of bacteriostatic pork chops during storage (2) 0.5% can be substituted for 0.25% in a bacteriostatic pork formulation; and (3) additional research is needed regarding the stability of acetone as an antioxidant for bacteriostatic pork.

The authors concluded that (1) the relationship between collagen content and mechanical resistance is not as tight as previously reported (2) the relationship between collagen content and elasticity is not as tight as previously reported (3) the relationship between collagen content and mechanical resistance is not as tight as previously reported (4) the relationship between collagen content and mechanical resistance is not as tight as previously reported.

According to study 2, the use of 0.5% and 0.75% in combination with 0.25% and/or 0.5% was effective in maintaining acceptable color and flavor and low moisture sorption. The authors also noted that the use of 0.5% and 0.75% had no significant effect on the stability of acetone as an antioxidant for bacteriostatic pork.