SESSION 8. ANALYTICAL METHODS

8:1

APPLICATION OF THE "MYOGLOBIN METHOD" FOR THE IDENTIFICATION OF MEAT SPECIES IN HEATED MATERIALS

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In 1986 an electrophoretic method (IEF) for meat species identification has been established using the patterns of myoglobins which are specific for animals which are not very closely related (called myoglobin method).

Meat with a low content of myoglobin (e.g. pork or chicken meat) and heated material is difficult to be recognized by this method.

This paper describes the improvement of the visualisation of the myoglobin patterns by using a specific staining method which is based on a myoglobin induced catalytic oxidation of an organic compound (e.g. o-dianisidine) by hydrogen peroxide forming a brown-red colour. This method is very sensitive so that pale meats and heated meats can be identified in general without difficulties. Ultra thin and rehydratable polyacrylamide gels having several advantages were used.

The myoglobins proved to be the most stable of the sarcoplasmatic proteins against storage, freezing and heating as well. Therefore, the myoglobin method is more useful than the isoelectric focusing and staining of the whole sarcoplasmic proteins.

It was found that the isoelectric points (i.e. the positions of the myoglobin bands in the IEF-gel) are not influenced by heat treatment. In some cases (e.g. beef) the myoglobin patterns can be visualized without concentrating the meat extracts even after heating to 100°C. If the myoglobin content is too low a concentration of the myoglobins can be arranged by its adsorption on hydroxylapatite, followed by its desorption with phosphate buffer.

The electrophoresis is finished after about 2 hours, the staining reaction after 15 minutes. The stained gels can be dried and stored easily. There is no change of the colour and no decrease of the intensity of the patterns during storage of the gel.

8:2

PROXIMATE ANALYSIS OF BEEF SAMPLES BY NEAR-INFRARED REFLECTANCE SPECTROSCOPY

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The use of near-infrared reflectance (NIR) spectroscopy for proximate analysis of meat has been only partially successful. This study investigated the influence of various aspects of sample preparation and differences between sample types on the usefulness of the NIR technique.

The samples of meat used in this study were beef samples taken for purposes of carcase evaluation from 70 steer carcases. A 3-rib (10th to 12th) cut and a portion of the *M. longissimus dorsi* were the sample types used. The rib cuts were boned and both the rib and *M. longissimus dorsi* samples were minced sequentially through 10, 5 and 2 mm screens. Samples were chemically analysed for moisture (oven), protein (Kjeldahl, automated) and fat(specific gravity, Foss-Let) in duplicate.

Various techniques for producing tissue homogenates for NIR analysis were tested, using top-driven (Ultra -turrax) and bottom-driven (coffee-grinder, bowl cutter) type homogenisers and using both thawed and frozen samples. Samples were read on an InfraAlyzer 400R (Technicon Instruments, Ltd.) at 19 wavelengths in the region 1400-2400 nm. Samples were read as duplicate packings in open cups, with each packing being read twice after rotation of the cup through 180 degrees. Reflectance data were collected as log 1/R values for each of the 19 wavelengths. Calibration (n=40) and prediction (n=30) sets were chosen by random selection and used to develop and test calibrations for moisture, protein and fat. Calibration was carried out using an all-possible combinations search for two to five wavelength terms. The derived calibrations were evaluated on the prediction set.

Good calibrations, particularly for moisture and fat, were obtained for the 3-rib cuts due to relative ease of sample homogenisation and the wide ranges of values in this sample type (moisture: 42-65%, protein: 13-20%, fat: 15-39%). By contrast, considerable difficulty was experienced in preparing suitable homogenates of *M. longissimus dorsi* samples. The narrow ranges of values in this sample type (moisture: 71-76%, protein: 22-25%, fat: 1-5%), coupled with the sample preparation problem, resulted in relatively poor calibrations for the NIR analysis.

Analysis of sample cuts, such as the 3-rib cut, for carcase evaluation may be undertaken successfully by NIR but more difficulties are experienced in applying this technique to the analysis of meat, such as *M. longissimus dorsi*, of low fat content and of less variable composition.

8 : 3

THE SEPARATION OF MYOFIBRILLAR PROTEINS USING ISOELECTRIC FOCUSING

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The separation of myofibrillar proteins by electrophoretic techniques is hindered by the lack of solubility of the proteins in low ionic strength buffers. Thus, electrophoretic separation in polyacrylamide gels is generally achieved in the presence of the detergent sodium dodecyl sulphate (SDS). Isoelectric focusing (IF) is often considered to provide greater resolution of proteins than conventional polyacrylamide gel electrophoresis (PAGE) due to the concentrating nature of the technique. Isoelectric focusing would therefore represent an improvement in the techniques currently available for electrophoretic separation of salt soluble proteins from meat. However, problems are encountered in retaining solubility of the proteins during electrophoresis. IF is not compatible with the use of SDS which destroys the isoelectric characteristics of the protein. Furthermore, high salt concentrations cannot be used for protein solubilisation in samples to be subjected to IF. This paper reports a method for the separation of myofibrillar proteins using urea and mercaptoethanol to ensure the solubility of the proteins. Agarose was chosen as the support material for separation of the proteins as large pore gels can be prepared, which facilitates resolution of proteins of high molecular weight.

The method described allows the separation of several proteins from the meat extracts and differences can be observed in the number and isoelectric points of the proteins extracted from different meats and also following different periods of storage. In comparison to results reported using SDS PAGE, better protein resolution is obtained using IF. The technique described is likely to be particularly advantageous in achieving separation of large molecular weight proteins which migrate only a short distance into SDS polyacrylamide gels.

Present work is directed towards the separation of myofibrillar proteins from additional species and following different postmortem conditions. The improved separation of the myofibrillar proteins achieved using IF could have potential applications in meat species identification and in the investigation of changes in the structural proteins of meat during conditioning and processing.

8 : 4

DETECTION AND EVALUATION OF LARD ADULTERATION IN PURE BUFFALO AND COW BUTTER

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This investigation was carried out in an attempt to assess the most reliable methods for detection and evaluation of lard adulteration in pure buffalo and cow butter.

Fatty acids composition of lard; buffalo butter and cow butter as well as certain experimental mixtures with 3; 6; 9; 12 and 15% lard were determined by using a PYE unicam (GDC) Gas Liquid chromatography apparatus with S 8 autosample.

The quantitative determination of the different acids was performed by measuring the peak area with an Hewlett pachard integrator 3390 A.

Methods based on enzymatic hydrolysis of triglycerides and the proportion of fatty acids at B-position of triglycerides, applying GLC method were assessed.

In addition, feasibility of applying some calculation factors (palmitic acid enrichment factor; unsaturation ratio, total C_{16}/total C_{18} fatty acids in B-monoglycerides; staurated/unsaturated fatty acids in B-monoglycerides and USU/SUS ratio) as a criteria for the detection of lard contamination were performed.

The results showed that the quantitative fatty acid composition markedly varied in lard than that in pure buffalo and cow butter. In general, it is clear from such data that lard contained more unsaturated fatty acids (57.851%) than pure buffalo and cow butter (24.434% and 24.603%, respectively).

The linoleic acid ($C_{18:2}$) component in lard; buffalo butter and cow butter was found to be 10.678%; 2.578% and 2.895%, respectively. While, the stearic acid ($C_{18:0}$) component was markedly lower in lard (11.231%) than that in buffalo butter and cow butter (19.159% and 18.862%, respectively).

The data showed that palmitic acid enrichment factor could be helpful in detecting lard in pure buffalo and cow butter, as it markedly increased as lard percentage was increased; unsaturation ratio; total C_{16}/total C_{18} fatty acids; saturated/unsaturated fatty acids and USU/SUS ratio could be recommended as a criteria for lard contamination in buffalo and cow butter.

8:5

SPECIES IDENTIFICATION OF INTERNAL ORGANS USING ANTISERA TO THERMOSTABLE MUSCLE ANTIGENS

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Thermostable organ antigens (TOA) were extracted from the liver, heart and kidney of 5 wild and 2 domestic animals. Identification of the species of origin of the TOA was successfully done using goat antisera to thermostable muscle antigens (TMA) in immunodiffusion tests. When tested against the homologous TOA, the species-specific TMA was shown to exist as:

i) cross-reacting antigen present in the serum of homologous species and in heterologous TMA.

ii) species-restricted antigen found in muscles and organs.

iii) striated muscle specific antigen restricted to heart and skeletal muscles.

iv) tissue specific antigen found in skeletal muscle only.

Antisera to thermostable muscle antigens are useful for species identification not only for fresh, cooked and autoclaved meat, but also for internal organs.

8:6

RELATIONSHIP BETWEEN SKATOLE CONCENTRATION IN BACKFAT OF GILTS AND ENTIRE MALE PIGS FROM THE SAME HERDS

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With the purpose of investigating whether the skatole content in entire male pigs is reflected by the skatole content in gilts, we have analysed backfat from 5.000 gilts and 5.000 entire males from 10 herds.

In earlier investigations we have registrered the frequence of boar taint measured as skatole content in several herds. The frequency of boar taint has varied much between herds. From these herds we chose 10, so that low, middle, and high frequence of boar taint were represented.

Each herd produced 500 gilts and 500 entire males. The 10.000 pigs were produced, slaughtered and analysed during 12 month.

The results showed a high correlation (R = 0,95) between the frequence of entire males judged as tainted (skatole concentration > 0,19 ppm) and the frequence of gilts with a skatole concentration of more than 0,14 ppm, both taken as the mean over 3 months.

In some of the herds there was variation in skatole concentration from month to month. There was also a correlation between the two parameters in the same herd during time.

It is concluded that the skatole concentration in backfat from pigs is highly influenced by the invironment.

It is concluded too that it is possible to estimate the frequence of boar taint in entire males in herd without producing entire males by analysing skatole concentration in backfat of gilts from the same herd.

8:7

THERMOGRAVIMETRIC ANALYSIS: DETERMINATION OF THE RATE OF VOLATILE COMPOUND FORMATION FROM BOAR M.SEMIMEMBRANOSUS INTRAMUSCULAR LIPIDS

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The rate of volatile compounds formation from boar M.Semimembranosus total intramuscular lipids was investigated on the basis of noniso-thermal thermogravimetric (TG) analysis. The investigations were performed at different heating rates (q,^{o}/min) in oxygen and nitrogen atmosphere (2.5;5.0 and 10.0 ^{o}/min). The standard fresh samples of intramuscular lipids were obtained by a corresponding extraction procedure according to Folch. Comparative analysis in N_2 and O_2 was performed in order to determine the difference in the rates of volatile compounds formation with and without the chemical -oxidation reaction. TG analysis was always done with the same initial sample mass (less than 10 mg) and in the temperature interval 30-250^{o}C. The rate of formation of volatile compounds (v.c.)was derived for temperatures greater than 130^{o}, when significant mass change occurs (Δm% more than 1%).

The derived equations for the rates of volatile formation ($r_{v.c.}$) (130-250^{o}) are:

$r_{v.c.}(O_2)$=2,539q(100-Δm%)exp(-7400/T),%mass of m_o/Kmin

$r_{v.c.}(N_2)$= 393q(100-Δm%)exp(-6960/T),%mass of m_o/Kmin

The results of comparative DSC analysis, which was performed in the same temperature interval (30-250^{o}C) in inert argon atmosphere and in air, confirmed the increasing rate of formation of v.c. above 130^{o} in oxidizing atmosphere.

The proposed method for determining the rate of v.c. formation using TG analysis could serve as a standard procedure in the quantitative analysis of the rate of creation of compounds mostly responsible for odor and flavors from different sources (intramuscular lipids, fats, etc.). TG analysis also yields information about the thermal and oxidation stability of intramuscular lipids which are useful in defining different changes in composition of meat during pasteurization or sterilization process.

8:8

A COMPLETE SEPARATION OF MAJOR PHOSPHOLIPID CLASSES IN MEAT BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY WITH SUBSEQUENT GASCHRO-MATOGRAPHICAL ANALYSIS OF PHOSPHOLIPID-BOUND FATTY ACIDS

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In raw or processed meat as well as in blood samples and biopsies the phospholipid pattern becomes increasingly interesting. While phospholipids are always associated with other lipids, the separation and quantitation out of complex samples are difficult, especially when the phospholipid fractions occure in disproportional small amounts. It was the aim, to develop a sensitive High-Performance-Liquid-Chromatography (HPLC) method for the separation of major phospholipid classes and to collect the fractions for further determination of the fatty acid pattern of the single phospholipid classes by Gas-Chromatography (GC).

Materials and Methods

Total lipids from several tissues of pigs were extracted by chloroform/methanol and 4 mg of this mixture were directly injected into a HPLC unit (Merck, Darmstadt FRG) coupled with a 25 cm x 0.4 cm (5µm) Si 60 cardridge (LiChrocard, Merck) and a fraction collector (Gilson, France).

Phospholipids were measured at 203 nm by a UV-detector. A solvent system was developed based on the simultaneous use of a pH-gradient and a polarity gradient: After 5 min. acetonitril in the mobile phase changed to acetonitril containing 3‰ phosphoric acid; from the 15th min. to the 30th min. this system changed continually to methanol also containing 3‰phosphoricacid. The flow was held constant at 1 ml/min. The phospholipid fractions were collected and phospholipid-bound fatty acids were transfered by Na-methylate to fatty-acid-methyl-esters (FAMES) and analysed by GC (Hewlett Packard GC 5890, Waldbronn F.R.G.).

Results and conclusions

A baseline separation was achieved for Phosphatidyl-Cholin, Phosphatidyl-Ethanolamin, Phosphatidyl-Serin, Phosphatidyl-Inositol, Cardiolipin, Sphingomyelin, Lyso-Phosphatidyl-cholin and Lyso-Phosphatidyl-Ethanolamin in less than 50 minutes. It was possible to collect automatically the single phospholipid fractions for subsequent transesterification. Retention time and peak areas were highly reproducible also from the FAMES pattern of the phospholipid classes analysed by GC.
This method requires no derivatisation, cleaning steps or concentration procedures of the sample compounds, and is a great advantage over the usual Thin-Layer-Chromatography.
Further transesterfication of the phospholipid-bounded fatty acids and GC analysis with internal standards allows to recalculate the phospholipid pattern and, after phosphate-determination, the amount of each phospholipid in the whole sample.

8:9

CONSIDERATIONS REGARDING CONTROL MEASURING IN CONNECTION WITH AUTOMATIC MEASURING OF FAT- AND MEAT THICKNESS WITH THE DANISH OPTICAL PROBE

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In recent years, the thickness of the fat-layer on longissimus dorsi muscle has been utilized as a good indicator of the meat content of a carcass.

At the moment a measuring equipment is being tested in Denmark, which automatically executes an anatomically determined position and insertion of 18 measuring probes for the measurement of especially the thickness of fat on various spots of the carcass.

By the Danish optical probe is registered a reflection profile along an approx. 100 mm deep insertion. As fat reflects more light than meat, the profile is being used to determine the thickness of the fat-layer and the muscle. As the interpretation of the profiles and the value of the calculated thickness are to be carried out automatically, it is important that the algorithemes are robust towards all types of profiles. Because of the elaboration of algorithemes it is therefore necessary to have a large experiment material and a "key" in the form of control measurings. Furthermore it is important to have a method, by which it is possible to prove systematically measuring errors in the automatic measuring equipment, in consequence of e.g. wrong angles of insertion, wrong positioning or the like.

FAT-PERISCOPE PROBE.

The old method of visual reading of the fat thickness was resumed again, however, in a modified version, which as far as possible ensures accordance between profile and control measuring. Prefactory tests showed that, after a short training period reproducible measurements were obtained by the fat-periscope probe.

MANUAL PROFILE-MEASUREMENT, REPRODUCIBILITY AND CONTROL MEASURING OF THE FAT THICKNESS OF LONG. DORSI.

By manual insertion of a measuring probe two profiles were decided at each insertion point in long. dorsi. The average difference between fat thickness determined on the profiles from 1st and 2nd insertion point, respectively, is 0.4 mm (n=82, stdev.=1.4 mm) and is significantly different from 0. If the fat thickness calculated on the profiles from the 1st insertion point is related to the control measuring by a fat-periscope instead there was ascertained a significant difference of 1.6 mm (n=165, stdev.=2.0 mm). This difference is ascribed partly to the different friction at the insertions and partly to the difference of the two measuring equipments.

CONCLUSION.

Profile measuring is not completely reproducible and the profile fat thickness deviates approx. 1.5 mm from the control measuring. But the knowledge of the size of the deviations compared to the relatively small casual deviation (stdev. of the difference 1.4, 2.0 mm, respectively) ensures that the manual profile measurements combined with the fat-periscope probe measurements can be used as secure methods for checking profile measurements from the automatic measuring equipment.

8:10

ANALYSIS OF SODIUM AND POTASSIUM IN MEAT PRODUCTS

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According to the legislation in the Federal Republic of Germany, food-products with a reduced salt content can be labelled "severely reduced sodium content" or "reduced sodium content". For meat products that means a limitation of sodium to 0.4 g Na/kg (= 1 g common salt/kg or 0.1 %) resp. 1.2 g Na/kg. New regulations about products with reduced sodium content are intended. The limitations planned are 4 g Na/kg for liver and blood sausages, 5 g Na/kg for cooked sausage (Bologna- and Frankfurter-type) and cooked ham and 10 g Na/kg for salami-type sausage. The lack of a convenient, cheap and reliable official method for the determination of sodium in meat products led to this study.

We tested the accuracy of measurement with a cure meter, with flame photometry (Atom-Emission-Spectrometry = AES) and ion-sensitive electrodes (ISE). The cure meter is recommended for a fast judgement of completeness of curing and measures the electrical resistence in the sample. For the estimation with AES a special calculation-program, connected directly to the spectral-photometer, was developed. It corrects a time-depending drifting of results of the standard solutions and applies a non-linear calibration curve simultaneously. The calculation method can be used also for other methods with similar problems. With ISE three kinds of measurements were tested : 1. direct potentiometric estimation, 2. addition of sample solution to a buffer solution (analate) or addition of a buffer solution to the sample solution and 3. a double-addition-method, resulting in a self-calibration (also to use for Gran's Plot), combined with a continuous checking of the electrode.

The results with the very easy to use cure meter were not sufficient : Water content and other ions than sodium in the meat product influence the results and scale numbers show a strong staggering.

Measurement with AES is more reliable. The results were in good agreement with the salt-concentration applied. For the calculation a non-linear square-like calibration curve had to be used.

The advantages of measurement with ISE are precision and the price of instruments, a disadvantage was the long time before obtaining the results. This problem should be resolved by improvements of the electrode or by calculation of the point of equilibration. The good results of the analate method are preferable to the other ISE-methods. In several trials the concentrations of sodium measured by ISE and of chloride, by titration, were compared. The results were in good agreement. Additionally a faster method was tested: Addition of about 200 mg homogenized sample to a buffered solution of known concentration of sodium. The results were less accurate but the rapidity and simplicity of the estimation may be of interest for some users.

After estimation of sodium we tested AES and ISE for the estimation of potassium. There were similiar results in the judgement of the tested methods as described for sodium.

For the determination of sodium and potassium AES and ISE can be applied. Larger laboratories will prefer AES, smaller ones the ISE. The advantage of the first method is the rapidity of estimation, useful for a series of analyses, but the costs for the instrument are sufficiently higher. Besides the testing of methods different kinds of calculations for the AES and ISE were investigated.

8:11

A METHOD OF QUANTITATIVE DETERMINATION OF GLYCOSAMINOGLYCANES (MUCOPOLYSACCHARIDES) IN ANIMAL TISSUES AND SOME ORGANOPREPARATIONS

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The present paper discusses the results of a study of the procedure to quantitatively determine glycosaminoglycanes (mucopolysaccharides) in organs, tissues, medicines of the domestic production.

The suggested method is based on determining the level of glycosaminoglycanes by one of the constituents of the disaccharide units of their molecule, viz., hexosamine or uronic acids. For any individual glycosaminoglycane, optimum conditions of hydrolysis are chosen, which ensure the maximum yield of hexosamine. Uronic acids were deterimned without pre-hydrolysis.

The method is unified, highly sensitive, can be applied to determine the level of glycosaminoglycanes in raw materials (vitreous body, duodenum mucous membrane, eye cornea, hyaline cartilages, lungs) at different processing stages, as well to control the quality of the finished product containing glycosaminoglycane as a biologically active component.

8:12

ORGANOLEPTICAL EVALUATION OF COOKED SAUSAGES USING THE COEFFICIENTS OF SINGLE CHARACTERISTICS PONDERABILITY

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Meat products quality is characterized by a set of properties among which the organoleptical play a major role in total evaluation of product consumer acceptance.
Product quality is evaluated organolepticall-ly by a set of single parameters; determination of their ponderability in total score allows to increase the significance of each of them.
Coefficients of ponderability were determined using assessors evaluation and statistical methods.
Correlation of the abovementioned methods was analysed comparatively on the example of cooked sausages quality evaluation by appearance, colour on the cut surface, odour, taste, consistency and juiciness.
To determine coefficients of ponderability there were chosen two methods of assessors evalution - ranking and direct evaluation of ponderability coefficients - and one statistical - correlation analysis.
As the result of the obtained data analysis it was found that single organoleptical parameters of cooked sausages quality, taking into account their ponderability in total score, were given the following order: 1 - taste; 2,3,4 - odour, colour on the cut surface and consistency; 5 - appearance; 6 - juiciness.
The following total values of single organoleptical parameters ponderability degree were obtained: taste - 0.30; odour - 0.18; colour on the cut surface - 0.18; consistency - 0.18; appearance - 0.10; juiciness - 0.06.
It was found that the ranking method greatly corresponded to the correlation method of ponderability degree evaluation as compared to the method of direct evaluation.

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PASSIVE METHOD FOR DETERMINING ANIMAL'S BODY TEMPERATURE

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It is shown that the intrinsic SHF-radiation of the animal body can be utilized to evaluate its physiological state. It is demonstrated that measuring the power of SHF-radiation gives the data on the deep temperatures of test objects.

The developed radiothermometer allows measuring deep temperatures in different parts of animals to the nearest 0.1°C irrespective of hair condition, the measuring time not exceeding several seconds.

Deep temperatures in different parts of the animal body of beef cattle were taken with the above-mentioned radiothermometer. The results confirmed that the deep temperatures can serve the basis to control the physiological state of beef animals. The deep temperatures in the side region of the animal's body were found to be proportional to the rectal temperature usually utilized to generally control the health state of farm animals.

The application of a radiothermometer will make it possible to simplify the process of deep temperature measuring, this allowing automation of the process and the evaluation of the physiological state of farm animals.

8:14

THE DISTRIBUTION OF FAILURE DATA OF MEAT PRODUCTS

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OBJECTIVE

Determinations of the shelf-life of meat products are very often presented in the literature, but widely different methods are used for the evaluation of the data obtained.

The aim of this paper is to study the distribution of failure data of two perishable meat products, in order to compare alternative methods for the analysis of such data.

EXPERIMENTAL

Samples from 20 batches of frankfurters were stored at 2°-4°C and evaluated daily for spoilage by a panel of experienced judges, according to i) occurrence of surface microbial colonies and ii) development of off flavor.

Samples from 20 batches of hamburger mix were also stored at 2°-4°C and tasted daily for off flavor development (iii).

The sensory test was an acceptance/rejection single-sample one. Statistical significance of rejection was determined according to a binomial distribution with p=0.1. Complete failure data were compiled, but records were kept of censoring times, to allow incomplete data analysis to be carried out as well.

Cumulative frequency distributions for complete failure data of i), ii) and iii) were compared with those of normal distributions of equal mean and variance, by a Kolmogorov-Smirnov test.

Hazard plots for five different theoretical distributions: Weibull, normal, log-normal, extreme value and exponential were made and tested for goodness of fit of the experimental data.

RESULTS AND CONCLUSIONS

The cumulative frequency distributions of the complete failure data for i), ii) and iii) did not differ significantly from those of the corresponding normal distributions.

Good fits were obtained in hazard plots for the Weibull and log-normal distributions for i), ii) and iii). The fit of the normal hazard plot was also good for iii), and acceptable for i) and ii).

The percentiles of these distributions were in very close agreement among them. Typical results were, for the 50% percentile of i): 10.1; 10.4; 10.1 days for the Weibull, normal and log-normal hazard plots, and 9.3 days for the corresponding normal distribution. The latter did not, however, differ signficantly from the hazard plot percentiles.

8 : 15

A NEW MEASURING SYSTEM TO STUDY THE RHEOLOGICAL PROPERTIES OF MEAT DURING HEATING

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A new measuring cell for attachment to the Bohlin Rheometer was designed to study rheological changes in meat during heating. Meat samples (5 x 13 mm cylinders) were glued with cyanoacrylate to the lower and upper parts of the measuring cell, which was filled with a low-viscosity silicon oil. The temperature of the sample was monitored using a thermocouple attached to the measuring cell near the sample. The whole system was subjected to oscillatory shearing. The rheological parameters: the storage modulus (G'), the loss modulus (G") and the phase (δ) were monitored continuously during heating from 30 to 85 ^{o}C at a preset heating rate of 1 ^{o}C/min. The device was tested with M. longissimus dorsi of pork, and beef having different pH-values. The results showed that G' for pork meat was higher than for beef. The pH-value of beef had an effect on the temperature where G' started to increase: The lower the pH the lower the temperature.

8:16

Early prediction of PSE and DFD meats by infrared thermography on live animals

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The halothane test is a useful mean for the screening of PSS pigs. However, it is time consuming and cannot be applied on line in commercial slaughterhouse to predict meat quality. In this work, we measured the heat irradiation from live animals by infrared thermography as a stress indicator. Infrared measurements were compared to meat quality parameters for PSE and DFD.

A portable radiometer Raytek II was used to measure the skin surface temperature emission over the dorsal part of commercial porks just before stunning. At 45 min. post-mortem we measured pH 1 in the LD muscle. Water holding capacity by a press method, color with the Hunter Lab system, and pH 2 were also measured in the LD at 24 hours post mortem.

pH 1 was found unsuitable to predict meat defects. Lightness (LH) and yellowness (bH) of the Hunter system and water holding capacity were retained to identify PSE and DFD, both extreme and moderate. The incidence of PSE and DFD meats increased with an increasing skin surface temperature from 70^{o}F to 95^{o}F. However 73% of the 50 porks having thermographic values over 90^{o}F showed meat defects. Of this, 6% has been classified as moderate PSE, 39% as PSE, 22% as moderate DFD and 33% as DFD meats.

Although this new approach still needs improvements with larger populations, infrared thermography of live animals seems to be a practical, rapid, inexpensive and not intrusive method that could be used on line to predict subsequent meat quality defects related to PSS.

8:17

OBJECTIVE DETECTION OF PSE/DFD PORK USING ELECTRONIC GRADING PROBES

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Three electronic grading probes, the Hennessy Grading Probe (GP-II), Fat-O-Meater (FOM), and Destron's Pork Grader (PG-100) were evaluated for their ability to detect PSE/DFD pork 60 min or 24 hr post-mortem (PM). As these probes use the differential light reflectance characteristics of fat and muscle to measure their thicknesses, information on the internal reflectance of the m. longissimus was also recorded by using an additional software function provided by the respective manufacturer. The strength of the relationship between mean internal muscle reflectance, calculated by averaging all reflectance values less those recorded for the first and last 4 mm of muscle thickness, and quality was then used to assess the three probes.

The number of carcasses probed at 60 min PM were 712, 976 and 229 with the GP-II, FOM and PG-100, respectively, and at 24 hr PM, 536, 734 and 268. Carcasses were probed at the 3/4 last ribs, 7 cm lateral to the mid-line on the left side. The overall quality of the boneless loins was subjectively assessed 24 hr PM using a 5-point descriptive scale developed by Agriculture Canada, (paleness: extremely pale, pale, normal, dark, extremely dark; texture: extremely soft and exudative, soft and exudative, normal, firm and dry, extremely firm and dry).

The correlations between the mean internal muscle reflectance and quality scores were as follows: at 60 min PM, GP-II: -0.42 and -0.37 for paleness and texture, respectively; FOM: 0 and -0.02; PG-100: -0.29 and -0.30 and at 24 hr PM, GP-II: -0.68 and -0.58; FOM: -0.53 and -0.50; PG-100: -0.45 and -0.49.

Initially, the results suggested that the detection of PSE/DFD pork was not satisfactory at 60 min PM but possible at 24 hr PM. However, a closer examination of the distribution within each quality score of the mean internal muscle reflectance at 24 hr PM revealed a considerable degree of overlapping between scores. This overlapping suggests that the electronic grading probes tested in this study were also unsatisfactory for detecting PSE/DFD pork at 24 hr PM, despite relatively promising correlations between mean internal muscle reflectance at 24 hr PM and quality scores.