A list of the Meat Courses currently offered at Kansas State University will be included in the conference proceedings. Our teaching responsibilities extend into the beginning course in Animal Husbandry, since evaluation classes of cattle, sheep and hogs are slaughtered, and carcass information is discussed by meat personnel.

Our beginning meat lecture and laboratory are similar to those taught at other institutions. One recent addition to our meat lab course is a sausage lab in which each class prepares at least one emulsion type sausage and several other varieties. This helps students to understand the principles of sausage manufacture and some of the associated problems. We have recently added cookery labs in which we try to illustrate the desirability of cooking less tender cuts by moist heat. Shank cuts are both simmered and broiled. Both elastic and collagenic connective tissue are braised in order to show that collagen is broken down while elastin is not. All students make guesses as to percent cooking loss of a roast. Eating is a desirable part of a cooking lab. An effort is made to acquaint students with lamb and with one or several organ meats as many have not tasted these delicacies, but hold prejudices against them.

An interest holder in live animal evaluation is to have all students calculate live value by one or several livestock buying techniques and then have an "auction." Actual live value is obtained and all students find out if they lost or made money. In the course "Principles of Meat Evaluation," all methods currently used in comparing pork carcasses are used and carcasses placed by each method. This affords an excellent opportunity to critically discuss current methods of carcass appraisal.

The course, "Animal Husbandry Problems," offers a real challenge to the instructor and the student. This can be a means of interesting potential graduate students in research, and hopefully a problem should raise more questions than it answers. Recent problems completed in Meats have included a comparison of weiners offered for sale in Manhattan stores, the development of visual aids for meats teaching (by a graduate student in Ag Education), an evaluation of several buying systems for cattle, hogs and sheep (by a young man who will be a hog buyer for Swift and Company), and the effect of dietary iron in hog rations on cholesterol deposition in the aorta. A good problem for a student who is graduate material should familiarize him with some laboratory techniques (chemical, histological, etc.). He should collect his own data and perform a statistical analysis, if needed. A list of possible special problems for undergraduate students should be kept at hand and added to as ideas come to mind.
It is felt that our meats course work at Kansas State University is currently lacking a course at the senior-graduate level in which meat technology or science would be stressed.

This past year a National Science Foundation Grant for Aid in Undergraduate Instructional Equipment was received. The major piece of equipment to be purchased is a freeze drying apparatus with cam temperature programming, and continuous recording of product weight and temperature. The NSF funds also will be used to obtain a microprojector, a cryostat and microscopes. More basic lab equipment such as an analytical balance, recorders, pH meters, a Kjeldahl apparatus, and a spectrophotometer will be purchased. Equipment for fast determination of moisture and fat will also be obtained.

I have included a course outline and lesson plans in the appendix. These were sent in with the grant proposal and some of them may not be workable. However, I hope some may contain ideas that can be included in Meat Science Courses at other institutions.

The most recent development in our Meat Education program is the approval of a graduate program in Food Science, so M.S. and Ph.D. degrees may be offered. This is a committee type program encompassing eight departments. While we may encounter many problems with this program, it represents progress for the Kansas State Meat Education Program as formerly we could offer only the M.S. degree.

In closing I wish to give credit to D. L. Mackintosh whose work, preserverance and imagination have made the Meat program a tremendous asset to Kansas State University. I want him to know that many of his ideas and techniques will be used at Kansas State University and at other institutions for many years to come.

APPENDIX

I. Currently Offered Meat Courses

A.H. 250 Elements of Meat Processing 2 credits

A lecture recitation course intended to emphasize the relationship between livestock production and the finished product, basic knowledge of meat and principles of various processing methods. Subject matter includes meat definition, consumption and composition; livestock buying, humane slaughter, inspection, rigor mortis, aging, preservation techniques, grades and grading, meat cookery, sausage, tenderizers, by-products, and promotional agencies.

A.H. 260 Meat Processing 1 credit

This is a laboratory course that meets 3 hours weekly. Material covered includes:
Live Animal Evaluation of Beef, Lambs and Swine in terms of Grade, Dressing %, Muscling, Fat Thickness, and Value.

Demonstration of Slaughter of Beef, Lambs, and Swine.


Muscle and Bone Anatomy of the Meat Animal Carcass.

Carcass Breakdown into Wholesale and Retail Cuts and Expected Yields of the Cuts.

Identification of Retail Cuts and proper cooking methods.

Carcass Grading of Beef, Lamb, and Pork.

Effect of Grade, Weight, and Class of Carcass on Edible Product Yield.

Principles and Techniques of Meat Curing - Illustrate various methods of curing - Demonstrate color reaction - Discuss Federal regulations - curing problems.

Packaging of Meat for the Freezer.

Principles and Techniques of Sausage Manufacture - Discuss sausage formulation - Manufacture several types of sausage so as to illustrate principles of sausage processing - Critique of product.

Meat Cookery - Illustrate principles of various cooking methods, cooking loss, effect of cooking upon collagenic and elastic connective tissue.

A. H. 270 Principles of Meat Evaluation 2 credits

A lecture - discussion course which meets 3 hours a week. This course is intended to cover the fundamental principles of live animal and carcass evaluation techniques. The following areas are covered:

Gross and Histological Composition of the Meat Animal Carcass and Changes in the Carcass During Growth.

Effect of Grade, Weight, Class (Sex), Nutritional Regime, and Management Practices upon Carcass Composition.

Subjective and Objective Standards Used in Evaluating Carcasses and Cuts.

Evaluation Techniques - Discussion of principles, advantages and disadvantages of many techniques which range from grade and live animal measurements to very refined techniques such as Ultrasound, Potassium-40, and Chemical Analysis.
A.H. 280 Meat Selection and Utilization 1 hour lecture recitation and 3 hours lab. per week.

This course is offered to Home Economics students or any others interested. It is a required course for majors in Foods & Nutrition and Institutional Management. An endeavor is made to acquaint these students with the meat industry in general and with wholesale and retail cuts of beef, pork, lamb, and veal. Students become highly qualified in identification of wholesale and retail cuts as well as edible by-products and sausage or prepared meats.

- **Pork** - Demonstration and participation in cutting pork. Identification of retail cuts is stressed.
- **Beef** - Demonstration and participation in cutting beef.
- **Lamb** - Demonstration and participation in cutting lambs.
- **Curing** - Demonstration and participation in curing hams, bacons, and picnics.

**Grading**

- **Sausage & Prepared Meats** - A complete discussion of sausage. Types, ingredients and spices with limited participation in processing three or more types of prepared meats.

- **Inspection** - Federal, State and Local inspection are discussed.

- **Nutrition** - The nutritional value of meat is emphasized.

- **Meat Cookery** - Methods of meat cookery and when and how they should be used is discussed at considerable length.

- **Identification** - Considerable time and stress is placed on identification of all retail cuts of meat.

A.H. 450 Classification, Grading and Selection of Meats 1 credit

This course is designed primarily to instruct students in applying grade standards for beef, lamb, and pork carcasses and to prepare them to participate in Intercollegiate Meat Judging Contests.
A.H. 680 Institutional Meats 1 hour lecture - discussion 3 hours laboratory

This is an advanced course geared to the special needs of Institutional Management majors. The following areas are covered:

Muscle and Bone Anatomy of the Meat Animal Carcass.

Meat Cookery - Factors affecting cooking method - cooking losses - chemical and histological changes.

Meat Mathematics - Determining cost per serving of various meat products based on latest available research data.

Meat Specifications

Meat Grading - Principles - Effect of grade on eating quality and edible portion.

Meat Inspection

Trichinosis

Kosher Meat

Bacteriology of Meat

Processing Methods - Freezing, packaging materials and their properties - Curing - Sausage - Aging of Meat - Freeze Drying - Irradiation - Tenderizers.

Field Trip - To several meat purveyors.

Lab Exercises - Emphasize cost studies, and cutting tests involving beef, lamb, and pork carcasses, and wholesale cuts.

A.H. 675 Meat Practicums 2 credits 6 hours of laboratory per week.

This course involves a very detailed appraisal of live animals, of slaughter data, and carcass information. Chill and freezing curves are obtained and processing variables are studied.

A.H. 680 Technological Principles of Meat Processing 2 credits

Graduate course 2 hours lecture - recitation per week 2 term papers required. Topics discussed are:

Skeletal and Muscle Anatomy

Histology

Rigor Mortis
Muscle Contraction

Chemistry of Muscle, Connective Tissue and Fat

Meat Color and Factors Related to Color

Biochemistry of Various Processing Techniques

Muscle Tenderness and Related Factors

A.H. 690 Meat Packing Plant Operation 2 - 6 credits

This is an off-campus course. Conducted in cooperation with the Arkansas City plant of Maurer-Neuer Company. Two hours credit is allowed for four weeks participation with a maximum of 12 weeks. This is offered only during the summer and for graduate students only, who have enough knowledge of meat operations to benefit from the course.

With limited time the student selects the departments in which he is most interested and the first week must be spent in the yards with the buyer; and each lot of cattle or hogs is followed to the cooler.

The student at all times is in contact with the proper person in the office, the foreman of the department as well as the workmen. Each Saturday morning the student has a conference with his advisors of the week and presents his week's observations in writing.

DEPARTMENTS NORMALLY COVERED:

Yards - Beef Cattle and Hogs

Kill - Beef Cattle and Hogs

Coolers - Temperature charts, Cooler shrink

Pork Cut - Ham boning

Beef Break Down - Boning

Grading - Federal Grades - House Grades

Curing - Hams, Bacons, Weiners, Smoke House - Temperature - Time - etc.

Prepared Meats -

Rendering - Edible and Inedible

Inspection -

Sales - Including one or two days with salesmen on the road

Hides and Dog Food -
A.E. 880  The Meat Industry  2 credits

Assigned reading, reports and conferences related to the history, development and economic significance of the meat industry.

II. Course Outline and Lesson Plans (Sent in with NSF Grant application)

Period and subject.

1. Introduction and objectives.
   Muscle and bone anatomy.
   Muscle and bone anatomy (cont.).

2. Differential tissue development.

3 & 4. Proximate composition of muscle tissue.
   Basic methods of determining proximate composition.

5. Emulsions. Factors affecting their stability.

6 & 7. Color, color theory and measurement, factors affecting muscle color.
   Mid-semester exam.

8 & 9. The effects of chill rate on procine muscle characteristics.

10 & 11. The effects of ante-mortem treatment on post-mortem muscle characteristics.

12 & 13. The effect of freezing rate on muscle characteristics. Basic histological characteristics of muscle.

   Effect of treatment on histological characteristics and reconstitution of freeze dried tissue.


Several laboratory exercises are presented to illustrate their objectives and means of achieving the objectives.

A. Color - (2 laboratory periods).

   Objectives -
   1. Illustrate various theories regarding color, including the three dimensional theory of hue, chroma and value.
   2. Show principles of objective color measurement.
   3. Illustrate the oxygenation of muscle pigment and follow this with color reflectance readings.
4. Determine effect of type of light, light intensity, temperature and oxygen permeability of flexible film on subjective and objective color evaluations of bovine muscle.

Procedure

First period

1. Discuss color theory.
2. Show how to use reflectance colorimeter.
3. Illustrate other techniques of color measurement.
4. Freshly expose bovine longissimus dorsi to atmosphere. Follow myoglobin oxidation by use of color measurement techniques.
5. Expose bovine longissimus dorsi to oxidizing agent, reducing agent, carbon monoxide, and nitrous oxide to show how each alters color.
6. Divide class into teams. Each team responsible for following bovine muscle color reflectance as affected by one of the following comparisons:
   a. display at 34°F vs. display at 44°F.
   b. display under incandescent lighting vs. display under deluxe white light (fluorescent).
   c. display at light intensity of 100 ft. candles vs. 400 ft. candles.
   d. display wrapped in oxygen impermeable flexible film vs. display in oxygen permeable cellophane.

Second period

1. Summarize results of bovine muscle reflectance studies and discuss.
2. Have class mix pigments, mount and display color strips so as to illustrate hue, chroma and value of a portion of color spectrum.

B. Histology (2 laboratory periods)

Objectives

1. Show histological characteristics of all tissues commonly found in meat.
2. Show effect of freezing rate on muscle cell damage.


Procedure

First period

1. Project slides of various types of tissue and discuss.

2. Prepare muscle samples for freezing. Freeze one sample with liquid nitrogen, another in blast freezer at \(-20^\circ\) F and another in still air freezer at \(0^\circ\) F.

3. Freeze-dry muscle tissue.

Second period

1. Illustrate techniques of fixing, imbedding and staining.

2. Examine tissue slides to determine effect of freezing rate.

3. Examine slides of freeze-dried and reconstituted tissue.

4. Examine slides of several types of pork muscle tissue.

5. Discuss findings.

C. Freeze Drying (2 laboratory periods).

Objectives -

1. Illustrate principles of freeze-drying and obtain moisture removal curves.

2. Determine effect on sensory evaluation of product.

3. Determine effect of fat content and of pre-cooking upon freeze-drying.

Procedure

First period

1. Prepare product and begin cycle of process.

2. Discuss principles.

3. Pre-cook sample.

4. Determine moisture content of samples prior to freeze-drying.
Second period

1. Determine moisture content of freeze dried product.

2. Reconstitute samples and determine water content of reconstituted samples.

3. Determine expressible water contents by press method.


5. Compare moisture removal curves of various items.

6. Discuss results.

D. Effect of chill rate upon porcine muscle characteristics.

(2 laboratory periods).

Objectives -

1. Show effects of post mortem chill rate on muscle water holding capacity, color, firmness and tenderness.

2. Show effect of chill room temperature on muscle pH and internal temperature.

Procedure

1. Sacrifice 1 porcine specimen. Chill one side as quickly as possible in chill room of 29°F and chill other side at a temperature of 38-40°F.

2. Continuously record internal temperature and muscle pH for 24 hours post mortem. Determine temperature in both thick and thin muscle areas.

3. Compare two sides with regard to muscle color, firmness, water holding capacity and tenderness of cooked samples.

E. Effect of ante-mortem treatment upon porcine muscle characteristics.

(2 laboratory periods).

Objectives

1. Produce both a pale, soft, exudative pork muscle and a firm, dry, dark pork muscle by ante-mortem ingestion of sugar and by ante-mortem exhaustive exercise, respectively.

2. Compare post mortem muscle pH patterns.
3. Compare muscle with regard to water holding capacity, cooking loss, objective color readings, histological characteristics and tenderness as determined by shear.

First period

1. Provide all the sugar for 1 pig that it will ingest for several days ante-mortem. Subject other pig to 1 hour of exhaustive exercise on treadmill or 2 hours of periodic electric shock. (Do this prior to class).

2. Stun, exsanquinate, dress and chill as quickly as possible.

3. Take and record a continuous muscle pH reading for 24 hours post-mortem.

Second period

1. Remove muscle samples. Compare with regard to characteristics suggested in objectives.

2. Examine pH curves for 24 hours post-mortem.

3. Discuss results.

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DR. J. H. ZIEGLER: Obviously, we are going to forego any discussions and if any of you have any questions you will have the opportunity to catch either Don or Davy or one of the other staff members some time in the next day or so when we visit the meat laboratory and take it from there.

DR. DONALD KROPF: Thank you, John. I enjoyed working with you and members of your Teaching Committee. I do want to make an announcement--there are some slides that speakers have not picked up from yesterday. Please pick up your slides from the projectionist so we don't have to mail them to you. I think at this time I shall turn the program over to our Conference Chairman--Ellis.

ELLIS PIERCE: Thank you very much, Don. You have had an opportunity to hear one session of the program of the Committees on Education. There will be another session later in the day. We will now move into the area of the Committees for Research On and Application of Basic Properties of Animal Tissues. This section of the Conference program has been coordinated by Dr. A. Z. Palmer from Florida, and at this time it is my pleasure to turn the rest of the morning's program over to Dr. Palmer.

DR. A. Z. PALMER: Thank you, Ellis. Our Committee Chairmen have indeed been diligent in developing the program that you are to hear this morning and they have been prompt in meeting the deadlines that have been extended to them, all of our Committees will report with the exception of the Chemical Committee that is headed by Dr. Al Pearson. Serving on the
Committee with Al were Milt Bailey, Brad Craig, Darrell Goll, Dr. Hornstein and J. D. Sink. They developed a good program but in co-ordinating it didn't get in. A number of our Committee Chairmen have indicated an interest in having a little more time than we thought we had available initially for discussion so without further adieu we want to give them as much time as we possibly can so may I call on Dr. Jim Guenther who is Chairman of the Statistical Committee--Dr. Jim if you'll take over from here.

DR. J. J. GUENTHER: Thank you, Zane. Good morning ladies and gentlemen. I would like to introduce the others who worked on this program--Dr. Herb Ockerman, Ohio State; Dr. Ralph Bouleward, L.S.U. and that noted swine authority who helped last year, Old Steve Zobrisky from that Land Grant College West of the Mississippi. Steve didn't work this year, however.

Now, this is the first time that we are covering statistics, per se, at this meeting. We hope that you find this morning's introduction to this lady very interesting. Actually, I think we recognized--at least I did--the need for such a program quite some time ago when I had one of my friends tell me in all sincerity that, "Heck, I never run duplicates in any experiment. Suppose I get differences, I don't know which one to use." And he was sincere about this!

In looking for a definition of statistics, the best I could find was that "statistics is those professional activities engaged in by professional statisticians." Whatever that means. It's just like some of the answers they give us sometimes, I guess. In any event I didn't poll my friends to find out what a professional statistician was because I knew some of them would not give me a very nice answer. Many of them think statisticians are lying most of the time.

We decided to cut the formal presentation of this program down somewhat to allow more participation in the discussion period. Actually, there are two 30-minute talks and they will probably take about 20 minutes each. Then we should have ample time for a good old uninhibited Reciprocal Neat Conference discussion. This is what the two speakers want. They are standing up here and they want you to try to shoot them down. They have done this to us for many years--here's your chance to reciprocate.

Our first speaker is a local man. We have had two local men so far and we thought we would carry this out. He is head of the Department of Statistics here at K-State and has been on the campus some 25 years, I've heard. In contacting this gentleman, to get him to appear on the program, I was impressed by his understanding nature and his personal warmth and friendliness. When you have heard him, I'm sure you will agree. It is my pleasure, then, to introduce to you Dr. Holly Fryer, speaking on the subject entitled, "Precision, Error and Interpretation." Dr. Fryer.

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