It is a pleasure and a privilege to appear on the RMC program and share with you some ideas on teaching a meat processing course. In order to learn what other institutions are teaching in this area, I contacted 25 individuals at Universities and other institutions soliciting their ideas and suggestions. I would like to take this opportunity to thank those people for their response, and I was mildly surprised at the apparent interest in this area from all the people that I contacted. After reviewing their suggestions and drawing on the experience gained through initiating and teaching a course in Meat Processing at the University of Georgia for the past three years, I would like to offer the following course, not as the ideal meat processing course, but as a workable outline from which to start. Many of you will wish to vary the course to suit your own ideas, needs and situations. I am including a course outline for teaching on the quarter basis that is very similar to the one taught at UGA and an outline for a course taught on the semester system that was sent to me by Dr. Roger Mandigo, University of Nebraska.

It is my opinion that any course in processing should contain a balance between lecture or theory and laboratory or the practical. In the case of the course at UGA, there are two hours per week of lecture and two three-hour laboratory periods. The three hour laboratory periods were established to allow adequate time to manufacture and process most products. In some cases where processing schedules are longer than this period of time, the students will be responsible, on a rotating basis, for the continuation of the process. The course is given five quarter hours of credit.

The sequence of presenting material is strictly a matter of personal preference of the instructor as is the subject matter or course content. The instructor will be handicapped by a lack of a basic text; most of the information will have to be gathered from a variety of sources but this may not be all bad, either. Another difficulty an instructor will encounter will be separating facts from long established "theory" or "practices." Sausage-making lies somewhere between art and science and it will be in the task of the instructor to attempt to inject as much science into the course as possible.

I cannot overemphasize the need, in my opinion, for students to actually go into the laboratory, roll up their sleeves, and get into the exercise. This includes selection and analysis of the raw materials to be used, preparation of the product, the actual processing and evaluation of the results. In our school, Meat Processing is not a required course and we must therefore make the course interesting and appealing to attract qualified students. We also feel that we are training the student to work in the industry. When a student goes to work for any processor, large or small, (and regardless of the title of his job), he is not going to be asked to isolate a protein. We do feel that he will be asked to work with his hands as well as his head and we attempt to prepare them for that combination.

Let us examine the actual course outline as taught at UGA:

FOOD SCIENCE 368--MEAT PROCESSING

Course description: The theory and practices of meat processing including curing, smoking, and manufacture of sausage products. Two, one-hour lectures and two, three-hour laboratories per week. Five quarter credits.

Prerequisites: None (Beginning meats courses desirable)

Course outline:

Week 1--Introduction
(Lab)--Fat Analysis
Discussion--Processed Meats
(Lab)--Microbiological Analysis

Week 2--Pertinent Governmental Regulations
(Lab)--Fresh Pork Sausage
Meat Color
(Lab)--Ham Curing

Week 3--Meat Color (continued)
(Lab)--Smoked hams and boiled hams
Comminuted sausage
(Lab)--Frankfurters

Week 4--Formulation of Raw Materials
(Lab)--Frankfurters--Several formulas
Evaluation of frankfurters
(Lab)--Field trip to local meat processing plant

Week 5--Fat in processed meats
(Lab)--Bologna
Mid-term examination
(Lab)--Polish sausage
Week 6--Defects in Comminuted Meats
   (Lab)--Fermented sausages
       Fermented sausages
   (Lab)--Summer sausages

Week 7--Microbiology of Processed Meats
   (Lab)--Cervelat
       Sanitation
   (Lab)--Meat Loaves

Week 8--Statistical Quality Control
   (Lab)--Specialty items
       Statistical Quality Control (continued)
   (Lab)--Braunsweiger and Liver Loaf

Week 9--Marketing Sausage Products
   (Lab)--Chili and Hash
       Field trip to local supermarket
   (Lab)--Review

Week 10--Final Examination
   (Lab)--Preparation for class luncheon
   (Lab)--Preparation for class luncheon
       Class Luncheon

Course grade:  Mid-term examination--25%
               Final Examination --25%
               Term paper --25%
               Laboratory Notebook --25%
               100%

The following list of slides show equipment used, product made and
evaluation techniques:

Slides 1 & 2--Processing equipment
Slide 3--  Polish sausage in the smokehouse
Slide 4--  Franks of various formulas
Slide 5--  Frankfurter with cross-sectional slice
Slide 6--  Fermented dry sausage
Slide 7--  Emulsion type sausage
Slide 8--  New condition sausage
Slide 9--  Fermented semi-dry sausage
Slide 10-- Meat loaves made with NITDM, fat and added water variables
           (3x3x3 factorial arrangement of treatments).
Slide 11-- Frankfurters subjected to various treatments of coloring
           and smokehouse schedules.
Slide 12-- Instron testing machine for texture.
Slide 13-- Taste panel evaluation of meat loaves.
In summary, I hope that this presentation has kindled some spark of interest in the area of teaching a course in Meat Processing and Evaluation. The teacher will be limited only by his imagination and ambition. Again, I would like to express appreciation to all those who contributed their thoughts and ideas to this report.

FS 368--MEAT PROCESSING

Five credits--2 one-hour lectures, 2 three-hour laboratory sessions per week, ten weeks duration (one quarter).

Course description--The theory and practices of meat processing including curing, smoking and manufacture of sausage products.

Prerequisites: None (beginning meats course desirable).

Course Outline:

First week--(lecture)--Introduction to Meat Processing
        (lab) -- Rapid fat analysis of raw material and finished product
        (lecture) -- Discussion on types of processed meats
        (lab) -- Microbial analysis--total plate counts, coliform counts.

Second week--(lecture)--Governmental regulations pertaining to processed meats
        (lab) -- Fresh pork sausage manufacture and evaluation
        (lecture)--Meat color--formation and use of curing adjuncts
        (lab)--Ham curing--rapid curing and country curing

Third week--(lecture)--Meat color (continued)--Measurement of color formation; discussion of added coloring materials, and color defects
        (lab)--Process hams from previous laboratory (half of the hams smoked, the remaining hams processed as boiled ham).
        (lecture)--Comminuted sausage: theories of physico-chemical properties and structure: (1) the emulsion theory; (2) the protein:water matrix theory
        (lab)--Manufacture frankfurters; evaluate hams from previous laboratory

Fourth week--(lecture)--Methods of formulating raw materials into sausage products
        (lab)--Manufacture frankfurters of several formulas: all meat, with variety meats, all pork, chicken frankfurters, etc.
        (lecture)--Evaluation of all franks made and discussions
        (lab)--Field trip to local meat processing plant.
Fifth week--(lecture)--The role of fat in processed meats
  (lab)--manufacture of bologna (one or more formulations)
  (lecture)--Mid-term examination
  (lab)--manufacture polish sausage; evaluation of bologna

Sixth week--(lecture)--Discussion of defects in franks and bologna:
  "Fatting-out," hard peeling, air pockets, gelatin pockets, "re-work", etc.
  (lab)--start fermented sausage manufacture; evaluate polish sausage
  (lecture)--fermented sausages and starter cultures
  (lab)--remove half of fermented sausage for summer sausage, allow remaining sausage to continue to ferment

Seventh week--(lecture)--Microbiology of processed meats
  (lab)--prepare Cervelats; evaluate summer sausage
  (lecture)--Microbiology of processed meats and sanitation
  (lab)--manufacture loaves: pickle & pimento loaf, spiced luncheon loaf, olive loaf, etc; evaluate cervelat.

Eighth week--(lecture)--Statistical quality control in processed meats
  (lab)--manufacture specialty items; head cheese, souse, tongue loaf, etc; evaluate loaves from previous lab
  (lecture)--Statistical quality control (continued)
  (lab)--manufacture braunschweiger and liver loaf; evaluate specialty items from previous lab

Ninth week--(lecture)--Marketing sausage products
  (lab)--manufacture chili and hash; evaluate product from previous lab
  (lecture)--trip to several local supermarkets to compare merchandising techniques

Tenth week--(lecture)--Final examination
  (lab)--Preparation for class luncheon
  (lab)--Preparation for class luncheon
  (lecture)--Class luncheon

Course grade:  Mid-term examination--25%
                 Final examination-- 25%
                 Term paper--        25%
                 Laboratory notebook--25%
                         100%

References:

1. Personal notes accumulated over the years:
   a. Statistical quality control--O.E. Kolari
   b. Meat Plant Sanitation--J. A. Carpenter
   c. Review of literature on comminuted meat mixtures--D.D. Brown;
      C. W. Monagle, University of Georgia
   d. Many other references.
3. The Science Meat and Meat Products--J.F. Price and B.S. Schweigert
4. Current literature
6. Visking Manual (Union Carbide)
7. Notes and outlines from colleagues teaching meats courses at other institutions.

**REVISION OF ANIMAL SCIENCE 417 OR 817**

Catalog Description:

*Animal Science 417 or 817 (217). Methods of Meat Processing (Food Science and Technology 417 or 817). (3 cr I) Mandigo Lect 2, Lab 3. Prereq: An Sci 102 or 117, Micro 300, and BN 221 or Chem 251, or permission.*

A study of the modern meat processing industry, its operations and techniques. The fabrication, processing, preservation, sanitation, and utilization of meat and meat products. Actual laboratory preparation of processed meats and by-products of the packing industry.

Objectives:

The course will provide an introduction to chemical and physical principles which regulate processing methods. Included are discussions related to the fundamental methods of meat processing employed in the meat trade. The course is designed to furnish knowledge concerning the influence of processing practices upon meat merchandising as well as information related to meat processing equipment, quality control, and product development. Students should also be able to:

1. Discuss historical development of the manufactured meat industry in the U.S.
2. List the factors responsible for the development of processed meats.
3. Explain the chemical properties of meat, additives, and their combining influences and effects.
5. Discuss fundamentals of fermentations.
6. Discuss microbial control methodology and the practical application of sanitation.
7. List and differentiate various spices, seasonings, flavorings, and additives.
8. Explain operations and concepts of sausage equipment and maintenance.
9. Demonstrate an understanding of quality control procedures and their use.
10. List and explain pertinent points in label preparation and interpretation.
11. Discuss religious and ethnic factors and problems in manufactured meats.
12. Demonstrate skills in actual sausage and cured meat production.
13. Set up, use, and clean equipment used in production laboratories.
14. Demonstrate understanding of equipment, smokehouse, and other processed steps.

Need or justification:

Students who seek opportunities in the food field need an understanding and working knowledge of the manufactured meat and food products. This understanding will be useful to other students due to the heavy reliance on manufactured meats for the consumer.

Methods:

Lectures, guest speakers, field trips, and actual laboratory product preparation and demonstration will be used. Students will be expected to become closely involved in actual preparation of product in laboratory.

Relationship to other courses:

Students have been introduced to manufacturing in other introductory courses in Animal Science and Food Science and Technology. This course will permit student involvement in depth in the manufactured meat products. No other course is specifically designed and taught at this time on this subject matter.

Course Outline:

Week 1--Introduction to course (lecture)--Cured and smoked meats

Week 2--(Lecture)--History of cured meats
(Lab)--Cured Hams
(Lecture)--History of cured meats (continued)

Week 3--(Lecture)--Modern cured meats
(Lab)--Rapid cured hams, corned beef, pastrami, beef bacon, bacon
(Lecture)--Color chemistry and development--curing adjuncts

Week 4--(Lecture)--Smokehouse technology
(Lab)--Smoked pork loins, ribs, miscellaneous cuts
(Lecture)--Smoking and heat treatment

Week 5--First Hour examination
(Lab)--Lard rendering
(Lecture)--Lard products and technology
Week 6--(Lecture)--Emulsion chemistry
       (Lab)--Product Evaluation--Smoked Meats
       (Lecture)--Emulsion chemistry and defects

Week 7--(Lecture)--Physical and chemical properties of fat
       (Lab)--Fresh pork sausage, smokie links, bratwurst
       (Lecture)--Water holding capacity, pH, fat content

Week 8--(Lecture)--Raw product analysis and use
       (Lab)--Braunschweiger
       (Lecture)--Combining properties and ingredients

Week 9--(Lecture)--Fermented sausage products
       (Lab)--Summer sausage
       (Lecture)--Fermented sausage production

Week 10--Second hour examination
       (Lab)--Olive loaf
       (Lecture)--Microbiological control and methodology

Week 11--(Lecture)--Sanitation and practical application
       (Lab)--Tongue and souse
       (Lecture)--Seasoning, flavoring, and additives

Week 12--(Lecture)--Sausage equipment and maintenance
       (Lab)--New England style ham and salami
       (Lecture)--Quality control procedures

Week 13--(Lecture)--Labeling
       (Lab)--Franks and polish sausage
       Thanksgiving vacation

Week 14--(Lecture)--Flaked and formed meat products
       (Lab)--Flaked and formed meat products
       (Lecture)--Flaked and formed meat products (continued)

Week 15--(Lecture)--Religious and ethnic factors
       (Lab)--Field Trip--American Stores
       (Lecture)--Linear programming

Week 16--(Lecture)--Review
       (Lab)--Field Trip--Cudahy Dry sausage
       (Lecture)--Review
       Final Examination

References:


Meat Institute, Chicago, Illinois.
DON KROPP: Thank you very much, John, for relating your experiences and especially for your reassurance to me personally. You said that we learned from failures. I think that I was aware of that already and we have learned plentiously at Kansas State University. That is very reassuring. At this time we would like to open this up for questions from the group to John and again we want to ask that you be sure to state your name and your institution before you ask John the question. Do we have any questions for him?

CURTIS MELTON, TENNESSEE: John, I would be interested in your secret of how you get so much raw material to work with in your class. This seems to be one of our greatest problems. Also, what is your class size?

JOHN CARPENTER: Let me answer the one on class size first. Over the years it has been anywhere from 6 to 12 people per quarter and we teach it once or twice a year. In other words, every other quarter, and 12 people worked out pretty well because that's really quite a few people in a working type lab. Now as far as raw materials, that's a real good question and I'm glad you brought it up. We save all our raw materials from the slaughter classes. In other words, we bone out the head, the tongue, we save the spleens, and then also I work with the slaughter classes too, and with the man who is in charge of the actual meat plant operation and he saves cow meat. Every once in a while he'll slaughter a dairy cow and save the cow meat and he also saves pork trimmings, hams, etc. I coordinate my class needs with him. I give him a schedule so he knows what to save. We save all the odd ball type meat and we save tongues, cheek meat, and similar items from the pork and beef that we slaughter. We buy very few raw materials from the outside. Every once in a while we slaughter some mutton from the Animal Science Department and bone this out and freeze it until needed. We try to make a product that would be realistically comparable to that being made in the industry. We don't always use just high class beef and pork.

BILL SULZBACHER, USDA: John, along the same line you were discussing, do the students pay a laboratory fee, and if so, how much?

JOHN CARPENTER: No, the students do not pay a laboratory fee. The costs of the course like this are financed by the department. Again, we are working with the meat plant supervisor and can get an awful lot of meat pretty cheap, sometimes. Not only that, I keep banging the ear of my department head telling him courses like this are going to cost money.
It costs just as much money to teach the meat processing course as the chemistry or microbiology course. It is just as important, so if you can buy growth media, petri dishes or chemicals, you can also buy meat or fat or whatever else we need to manufacture meat products. I feed the dean some sausage too.

RON REA, ARMOUR & CO.: To what extent do you use the Instron Testing Machine in your evaluation of these products? I noticed you had something similar to a Lee Kramer. Is it for firmness, for actual tenderness or is it just for surface-skin evaluation?

JOHN CARPENTER: We use it only as a demonstration in class to show them what can be done so if they ever run up against it when they go to work, they'll know what it can be used for. In research work, we use it for measurement of what I call texture instead of tenderness.

DON NAUMANN, UNIVERSITY OF MISSOURI: John, you said the period after you prepare the product, you evaluate it. Will you describe the evaluation please?

JOHN CARPENTER: Well, this depends on the product, but generally we try to evaluate it just as it has come out of the smokehouse or the cooking process so it is put in the refrigerator to hold until the next period when it is taken out and evaluated. We evaluate, for example, the casing, the color, and so forth. If it is frankfurters, we evaluate the peelability. Then we slice the comminuted or finely ground product. We evaluate them for color, texture, air pockets and evidence of connective tissue and tissue of that nature. In case of ham, we evaluate it for firmness, color, shrink, gelatin pockets.

DON NAUMANN: Do you ever make reference to commercial products in that evaluation?

JOHN CARPENTER: Oh, yes, we do not necessarily purchase commercial products but we definitely make reference or if we want to make a comparison like on frankfurters, we may buy a couple of pounds of commercial type products just to compare.

RAY FIELD, UNIVERSITY OF WYOMING: We have a course something like this and we have about 15 students in every fall. We usually try to limit it to about that many. We call the course Meat, Poultry and Game Products and a good deal of the meat is meat brought in by the students, usually in boneless form. They make the product and afterwards we have evaluation every lab following the making of the product as well. This usually includes boneless deer, elk, and antelope that is brought into the lab by the students and it has been a popular course.

BOB HENRICKSON, OKLAHOMA STATE UNIVERSITY: John, you make no reference to the large area of fresh forms of meat, like hamburger patties, meat balls and this area. Do you not include this as processed meat or do you handle it in some other way?
JOHN CARPENTER: I have not included it in this particular course mainly because I don't have a patty-maker or forming equipment. I think it is important and probably should be included. Roger Mandigo has consented to let us put his outline in the proceedings and includes a section on formed meat and I think it is very important. But ours is a 10 week course and we just don't have time to include all of it and I am not trying to minimize the importance of it. I think if we had the equipment we might go into it.

FRED PARRISH, IOWA STATE UNIVERSITY: You mentioned rapid-fat-analysis, John, what methods do you use and do you determine protein also?

JOHN CARPENTER: No, we determine the moisture, and the fat both in rapid techniques. We use perhaps toluene distillation and something like O-Haus rapid moisture analyzer for moisture. We use the modified Babcock for fat analysis and then we calculate protein by difference because these are only rough estimates for the purpose of formulation.

DON KROPP: In trying to create a spectrum of problems, John, do you have any tips on how to make special samples that have flavor problems or problems in appearance or texture?

JOHN CARPENTER: I hope I understand your question. Do I know how to make bad products? The answer is yes.

DON KROPP: First, we appreciate your candid confession. Well, to illustrate a point here, we have had processors with paint absorbence problems and it's very easy to put a sample of ground beef in a plastic film bag with some paint and to show them how this would taste. This can be done with other absorbed problems or with microbial problems. Do you create special learning experiences like this?

JOHN CARPENTER: No, I haven't. I think something like this might be reserved for a class that may be a little further advanced. What I have been busily involved with is in teaching the basic mechanics of meat processing. Some of these students start from no knowledge as far as experience in knowing what happens in processing meat.

ROGER MANDIGO, UNIVERSITY OF NEBRASKA: We process all of our product under Federal Inspection which creates real problems because we sell everything. We can buy all our own ingredients or make them out of our own lab meat trim and we resell all the product that doesn't get consumed in our evaluation session. We stay in the black somehow and in relation to Don's question, we deliberately sabotage certain formulations in advance. For example, we have four braunschweiger recipes. One has no cure, one has no milk powder, one has three times as much water as needed, things like this. The only problem is getting them past the inspector afterwards. The students do a pretty good job of creating a few other product problems for us.
JOHN CARPENTER: Well, I would just like to comment on this. I think those type exercises do have some merits. The most dramatic one is the one where you leave out the nitrite.

DON KROPP: I think as your students go out they might help you. I have coached my students to watch for off flavored samples of all kinds and they do send them to me at Kansas State and we do use them for class work. Just recently we had a problem of somebody not rinsing a sanitizing agent off very well and we had some rather severe off flavor problems from sanitizing agent. Of course, that would be a very easy one to set up artificially as well.

BOB HENRICKSON: John, I just wondered if there is a set of recipes put together that are tried recipes that will work in a laboratory situation?

JOHN CARPENTER: I think we rely somewhat on the Visking manual and I think maybe Warren Tauber might be able to give you some help in that respect. Some of these formulas just accumulate over the years. You get one from here and there. You try something that works one time or some are actually experimental formulas.

DON KROPP: I guess I might ask John directly whether he would be willing to put some of the good Georgia recipes into his report in the R.M.C. proceedings. Frankly, I give a lot of credit to George Wellington for sharing some of his Cornell recipes with me. They have been some of the real good ones.

JOHN CARPENTER: I just want to add that we don't have any particular secrets or anything particularly unusual that we have developed that you probably don't already have at your disposal. I started this course about three years ago and I don't think I've taught it the same way twice and so we're still learning down in Georgia too. But we'll be glad to share whatever we have down there.

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DON KROPP: Our next speaker is the man that I consider to be the Dean of College Meat Judging Team coaches. Let me assure you, Lowell, that I'm using the word Dean in its most favorable connotation. This man, Dr. Lowell Walters, has maintained a rigorous training schedule for his judging teams. They were well coached, they were always ready to compete and he's going to talk to us today on "What Has Been the Value of Meat Judging and Evaluation Contests". Dr. Walters.